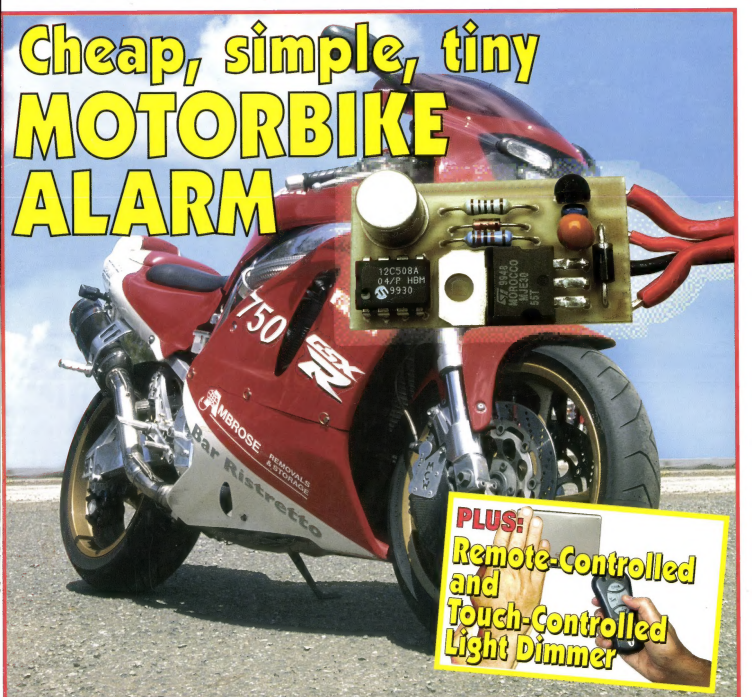
FAQs for the MP3 Jukebox

SILICON CHIP

JANUARY 2002
$6.60* INC GST NZ$7.50 INC GST
ISSN 1030-2662
PRINT POST APPROVED - PP255003/01272
siliconchip.com.au

PROJECTS TO BUILD - SERVICING - COMPUTERS - VINTAGE RADIO - AUTO ELECTRONICS

Cheap, simple, tiny MOTORBIKE ALARM



PLUS:
Remote-Controlled and Touch-Controlled Light Dimmer

To understand why $6,843 is a fair price to pay for VAF kit speakers, read 580 words from a violinist who can't use a screwdriver.

The following is an excerpt from a review which appeared in Audio Video Lifestyle Consumer Guide '99 by Sian O'Neale.

"Phillip Vafiadis is the creative talent behind the brand and his aim with VAF Research is to market kit loudspeakers of uncompromising quality at the serious end of the hi-fi market.

The VAF range is priced from $312 a pair right up to $8,863 a pair*, so we're talking serious money here for serious equipment.

We at AVL magazine have been particularly impressed with DC-X series.

These kit loudspeakers are not the standard packages from consumer electronics stores. In fact, you won't find these products in any store. The company prefers to cut out the middle-men and save buyers money, so every product is available factory-direct.

The VAF Signature series includes the Signature 1-66 and 1091 loudspeakers. Taking delivery of the 120kg 1-66 floorstanding speakers is something of an experience; I have never seen such an imposing crate for a pair of loudspeakers before. Fortunately my brother Crispin is capable with the screwdriver and we took out the massive 1-66s. You will need quite a bit of muscle and help to unpack these speakers and get them where you want them. The engineering and attention to finish that has gone into these fully assembled VAF Research 1-66s is simply awesome.

These elegant but powerful looking loudspeakers come with removable velcro attached grilles in a 3-way design; a 210mm hard paper bass driver with solid copper phase plugs and a 25mm double chamber sonotex dome tweeter with a pure silver wire voice coil. Turn the speakers around and you have very high quality gold plated binding posts which allow for bi-wiring and tri-wiring.

The same meticulous attention to detail and build quality also goes into the smaller 1-91 models, three of which are presented as left and right rear surrounds and a centre channel speaker for home theatre use (which has a custom-designed grille for a centre channel speaker). But the 1-91 loudspeakers have been designed to also perform as high quality studio monitors with the same superb sound as the 1-66s.

The speakers were designed to be used close to a rear wall and that's how customers use them, ideally 15cm-40cm from the nearest wall. But I think the speakers sound better when they can breathe more easily. Find the right position for the room and you will be richly rewarded.

The big VAFs deliver a stunning soundstage which is wonderfully insightful and involving. Large scale orchestral works have a level of depth and accuracy that only the best loudspeakers can manage.

As a violinist, I am often left unimpressed with the sound of the violin through so many loudspeakers (even high-end models), but here the presentation is accurate and engrossing. Instrument separation between different members of the orchestra is faultless.

This is particularly obvious when listening to Hans Zimmer's evocative soundtrack for The Thin Red Line in which quiet, gentle music provides so much power and atmosphere.

As a system for home theatre, together with the smaller satellite 1-91s, VAF has assembled an incredible system. Bass extension from the 1-66s is awesome; deep and thrilling, which is ideal for action blockbusters such as Speed, Twister or Titanic (you don't just watch the ship sink - you feel it through the floorboards). The centre channel speaker locks dialogue firmly into place and steers the sound with maximum impact; dialogue in Speed comes across as frantic as the driving. Full marks."

* Figures amended to reflect current pricing.

For the entire transcript of this review or information on our 14 models contact VAF Research and ask for your copy of "What the Critics Say". Free call 1800 818 882. Email vaf@vaf.com.au or surf www.vaf.com.au

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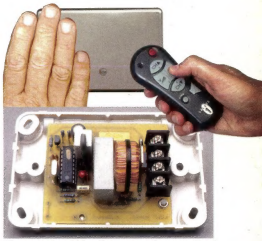

Touch And/Or Remote Controlled Light Dimmer – Page 22.

Cheap'n'Easy Motorbike Alarm – Page 53.

On the cover: *a larger-than-life view of our new motorbike alarm, pictured against a modified Suzuki GSX-R750WS. Thanks to Motorcycle Weaponry, Mona Vale, for the use of the bike.*

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Printing: Hannanprint, Alexandria, NSW.

Distribution: Network Distribution Company.

Subscription rates: $69.50 per year in Australia. For overseas rates, see the subscription page in this issue.

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ISSN 1030-2662

* Recommended and maximum price only.

PUBLISHER'S LETTER

Electronics Australia copyright will not be lost

A number of readers have expressed their sadness at the passing of "Electronics Australia" magazine, which was briefly mentioned in last month's editorial. In truth, I had very mixed feelings about it myself. On the one hand, it has been a tough competitor for SILICON CHIP, ever since we started in 1987 and now that it has gone, we have the field to ourselves. On the other hand, I and four other people on the SILICON CHIP staff, (Greg Swain, John Clarke, Ross Tester and Jim Rowe) all spent a great many years happily working for Electronics Australia and we read it for many more years, so a major part of our working lives has gone.

Still, it is not all bad. Following the demise of EA, quite a few people suggested that we should make an attempt to ensure that all the archive material and the EA website (www.electronicsaustralia.com.au) was preserved. And over the last few months we have had increasing numbers of enquiries about EA projects, photostat copies, etc. So in fact, before last month's issue went to press, we approached the publishers of EA to purchase all the copyright pertaining to EA, ETI and related titles and the above-mentioned website and domain name. This has now been accomplished, although at the time of writing, the material had not yet been transferred to us.

What this means for the immediate future is that the material on the EA website will be preserved and will be ultimately linked to the SILICON CHIP website. And since we now own the copyright, we will be able to provide photostats of articles in Electronics Australia. The charge for this service will be $8.80, including postage.

Unfortunately, we will not be in a position to offer technical assistance with EA projects – we simply do not have the time or any familiarity with the designs of past EA projects. Nor will we initially be able to suggest EA projects when readers enquire about particular circuit applications – again, we simply do not have a detailed familiarity with what has been published over the past 15 years in EA. That will come.

Importantly though, all the material that has been published over the life of Electronics Australia, going right back to the 1920s and the days of Wireless Weekly, and all the material associated with Electronics Today International (ETI), will be preserved. Ultimately, some of it may be republished.

Thanks to all those readers who have emailed, phoned and written in with messages of support and requests that we do not change our format. We greatly appreciate your comments and we will continue to strive to be the world's best electronics magazine.

Leo Simpson

MAILBAG

VideoScope improved with rack and pinion

I loved the VideoScope project in the October 2001 issue of SILICON CHIP. I just could not wait to get it up and going. However, I changed a few things for my own convenience. I used a rack and pinion from an unused camera tripod and turned a small wooden stand to fit a glass dish.

This makes focusing far easier. I study and collect ants and only need low magnification, 80-120. Other improvements would be a bellows between lens and CCD camera. I only used a B&W camera but was amazed at the picture quality. Top project!

G. Reynolds,
Wynnum North, Qld.

Critical transistors

I recently assembled a kit for your Ultra-Low Distortion Amplifier (described in March 2000) and in bench testing the finished product discovered the following. Distortion at supersonic frequencies was chronic and the waveform was covered in spurious garbage that would do awful things to many tweeters!

On further tests it was found that there was a definite 2nd pole to the frequency response that was not explainable from the circuit design.

The output devices supplied were genuine Motorola so suspicion fell on the MOSPEC-branded MJE15030/31 driver transistors. They were removed and tested and found to bear no relationship to quoted specs. Gain was very low, Vbe was erratic and F_t was in the kHz region!

Replacing them with a reliable branded type completely cleared the problems, giving clean waveforms well beyond 100kHz. As kit suppliers no doubt buy these devices in by the truckload, I imagine there could be a lot of substandard performing (if not dangerously unstable) amplifier kits in the field by now. Hope this alert is of use.

Kerry Williams, RMIT University,
Dept. of Applied Physics,
Bundoora, Vic.

Comment: this is correct – you must use genuine Motorola or On Semiconductor devices for the MJ15030/31 driver transistors in the Ultra-LD power amplifier. These same comments apply to the power amplifiers used in the Ultra-LD 2 x 100W RMS Stereo Amplifier.

Concern for copyright

I am responding to your editorial in the December 2001 issue. I guarantee you that I have never photocopied your magazine. Not so long ago my wife Pip was leaning over my shoulder to read an article and I instantly closed the magazine and said she would have to buy her own copy.

By the way, how about doing some interesting investigation. 3-pin mains plugs like those we have in Australia seem to be the same as used in parts of China, New Zealand and Argentina. Where did our 3-pin plug and socket design come from and why are they the same as used in those other countries?

Dick Smith,
Terrey Hills, NSW.

Transformer power rating for half-wave rectification

In the "Ask Silicon Chip" pages of the November 2001 issue, a reader asked why the transformer power rat-

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ing for a centre-tapped two-diode rectifier is 1.4 times that for an equivalent full-wave bridge rectifier, as noted in an ARRL handbook. You responded that the "VA rating" would be the same either way.

Vague recollections of my undergrad days percolated up as I read the letter and your response and I do believe the handbook is correct. For a given output voltage (V) and current (I) into a resistive load, a centre-tapped two-diode rectifier must be rated at a total 1.4 times average power: each winding is conducting only half of each cycle, which means that the RMS power in each winding is halved or 0.5 x 1.4 x VI.

However, the total transformer rating (ie, both windings) would be 2(0.5 x 1.4 x VI) = 1.4VI, or 1.4 times that for a bridge. So the centre-tapped configuration saves cents on the diodes but costs dollars on the transformer. I can't imagine it ever being used outside of academic study.

Ben Low,
via email.

Comment: in responding to the question we did not consider a resistive load since that is extremely rare. We considered it only for a capacitor-input power supply where the rectifier duty cycle, for both full wave and centre-tap configurations, is typically around 10% or less. This makes the 50% duty cycle consideration of a centre-tap transformer feeding a resistive load quite academic, as you suggest.

Windows XP review leaves questions unanswered

I just read your review on Windows XP in the December 2001 issue. All well and good and it was an interesting article but the review didn't go far enough, in my opinion. I know you are not a computer magazine, therefore the review should have covered some of the things that are of more relevance to us electronics types.

What should have been included was stuff like: How does it go when I want to program my AVR via BASCOM on a Dontronics DT006 board? Will the PIC programmer you published a while ago work with XP? Will Atmel's AVR studio work? What about the Mini and Maxi ABC boards and their software, or all the other projects that need a computer to program a micro, etc?

The main reason for those questions is that XP is based on the Win2000 core, which does not allow control of the parallel and serial ports by other applications; at least not without a lot of convoluted patching and loading of special programs that release the ports for general use, maybe! And XP is different to Win2000. A few mates of mine upgraded and a lot of their stuff, EPROM programmers, microcontroller programmers, etc that worked with Win2000 no longer work with XP.

Sure it is supposedly up to the developers of those projects and products to put out a patch for their software to run on XP but that could be many months away or never, if the redesign project is too big. In the meantime, everyone who converts to XP

expecting everything to work will be sorely disappointed. According to my mates, the ability of XP to emulate a previous version of Windows did not work with their equipment.

Yes, you can set up a dual-boot system, Win XP or Win 98. But then why bother with XP? – might as well stick with Win98 for all it's faults.

Is it worth your while to have an update to your Win XP article explaining the above or giving details of how to get everything working again? I for one won't even consider XP until I know that all my stuff will work.

There is no point to an OS that just adds a lot of "fluffy eye candy " and otherwise is not really better than its predecessors. All the multimedia stuff is another thing entirely and has nothing to do with my main point.

Keep up the good work. While I'm not a subscriber for no other reason than I never got around to it, I get every copy every month and have every issue since you started. And yes I agree with the editorial. Every one should go out and buy the magazine.

Ralph Teichel,
Ringwood North, Vic.

Comment: putting out a fairly comprehensive review of XP, as we did, is one thing. To try and answer all the sorts of questions you raise would take many weeks of work and then still leave many questions unanswered.

Electric vehicle article appreciated

I would like to thank you for your excellent article by Ross Tester on electric cars in the December 2001 issue. I am a mechanical engineer, a refugee from that other magazine and welcome intellectual stimulation. I remember a number of electric vehicles in UK 30 years ago, trains, buses, milk and bread floats and wonder whether electric vehicles are blokey enough for Australia.

Imagine going down to the pub and saying "I've just bought an Electric Ute with 10 Amp-Hour battery, twin overhead terminals and turbo ventilation". How can you lay rubber with an electric car or get that satisfying roar when you drop a cog to overtake a semi. Maybe manufacturers could incorporate speakers and a means to spray paint the road black. You could download a roar or rubber squeal from your favourite website.

On a serious note I have a few thoughts on the subject. I wonder if we also need to change the current infrastructure. While lightening the car to reduce the inertia and regenerative braking are all heading in the right direction, the car is still carrying all those heavy batteries. One possible option is to carry one or more battery packs depending on usage, to reduce this weight.

Also battery changeover rather than recharging seems a viable option, with battery changeover stations incorporated in the current petrol stations. Each battery would carry a chip encoded with information such as the last user and their credit details, the battery condition, etc. This information is downloaded to the battery supplier and credit company each time the battery comes back for recharging.

The vehicle would have its batteries under the vehicle and simply drive over a rack of batteries with their terminals on the sides touching busbars for charging/discharging and as one set of battery packs went in the other was ejected.

Looking at the hybrid engine, I see it is a piston engine. While rotary engines seem to have come and gone, they would seem to be the ideal choice for this application. Maybe Ralph Sarich's rotary could incorporate this change?

Tony Rossiter,
via email.

Lifetime support

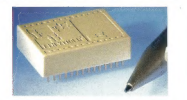
I was horrified to read that "Electronics Australia" has closed its publication after all this time. As a long-term electronics technician both for business and pleasure, I rely heavily on information and ideas that appear in your magazine.

I am hoping that you are not going to abandon us in the near future. Your magazine is my lifeline. I would be lost without you so keep up the good work. You have my full support for ever.

Kerin Sharp,
Morphett Vale, SA.

Comment: thanks for the support. We're here for the long term and we have no intention of changing format.

The Tiger comes to Australia



The BASIC, Tiny and Economy Tigers are sold in Australia by JED, with W98/NT software and local single board systems.

Tigers are modules running true compiled multi-tasking BASIC in a 16/32 bit core, with typically 512K bytes of FLASH (program and data) memory and 32/128/512 K bytes of RAM. The **Tiny Tiger** has four, 10 bit analog ins, lots of digital I/O, two UARTs, SPI, I²C, 1-wire, RTC and has low cost W98/NT compile, debug and download software.

JED makes four Australian boards with up to 64 screw-terminal I/O, more UARTs & LCD/keyboard support. See JED's www site for data.

TIG505 Single Board Computer

The TIG505 is an Australian SBC using the TCN1/4 or TCN4/4 Tiger processor with 512K FLASH and 128/512K RAM. It has 50 I/O lines, 2 RS232/485 ports, SPI, RTC, LCD, 4 ADC, 4 (opt.) DAC, and DataFLASH memory expansion. Various Xilinx FPGAs can add 3x 32bit quad shaft encoder, X10 or counter/timer functions. See www site for data.

$330 PC-PROM Programmer

This programmer plugs into a PC printer port and reads, writes and edits any 28 or 32-pin PROM. Comes with plug-pack, cable and software.
Also available is a multi-PROM UV eraser with timer, and a 32/32 PLCC converter.

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SEGWAY

Revolutionary Invention... or Expensive Toy?

Following months of media hype and speculation, inventor Dean Kamen's Segway Corporation have finally unveiled their unique machine – a scooter with an uncanny ability to replicate the balance and motion mechanisms of the human brain. While some analysts have touted that the creation will 'change the shape of cities', others remain unimpressed. In this article we take a closer look at the 'Segway' and its brilliant technical design (well, at least as close as we're allowed!).

By Sammy Isreb

It sounds as though it has the elements of immense success. With over $100 million in funding from America's top venture capital firms and designed by some of the top engineering minds available, Segway developed a product which gained some phenomenal media hype leading up to its release.

Adding to the hype, some amazing quotes from big names – "As big a deal as the PC": Steve Jobs – "Maybe bigger than the Internet": John Doerr, a venture capitalist who backed Netscape and Amazon.com.

So what exactly is the Segway HT (Human Transporter)?

A very fancy powered scooter would be the simplest answer. Based on a footprint of only 48cm by 63.5cm, the Segway is designed to take up as little space as possible.

Touted as a solution to inner city transportation woes, the Segway is meant to transport people quickly and efficiently, taking up no more room than a pedestrian.

It was never designed to replace cars, simply to provide an alternative for short distance commuting and to clean up densely crowded and polluted city areas.

It seems as though this admirable desire to simplify short distance commuting puts the Segway in the same market category as a myriad of other devices – bicycles, rollerblades, scooters and skateboards, to name just a few.

What sets the Segway apart from the rest is its safety, simplicity of use, and highly ergonomic design. The Segway was designed from the outset to mimic the body's natural sense of balance and motion. It uses some incredible sensory and computing technology simply to stay upright, providing unmatched ease of use.

To start moving forwards or backwards the user simply leans slightly forward or backward. Leaning further will increase speed, while moving towards centre will slow down.

It is a natural human response to try and upright one's body under panic. Segway uses this phenomenen to dispense with the need for mechanical brakes – as the user assumes an upright position it slows then stops completely.

Steering is as simple as twisting the handlebar, with the amount of twist determining the turning speed. Amazingly, the unit can turn on its own footprint, rotating on the spot.

Intelligent key

The amazing technology begins as soon as you start the Segway using the electronic "Intelligent Key". A 128-bit encrypted key word is stored on the key, which is required to start the particular unit it was shipped with.

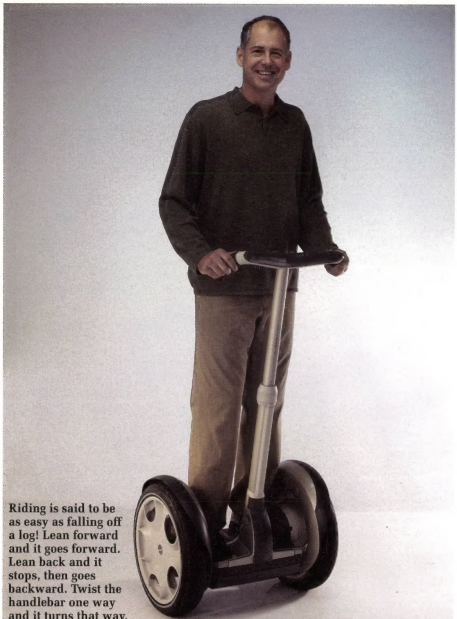
In addition to the security feature, the Intelligent Key also stores the user's profile, with all units supplied with "beginners" and "advanced" keys. The beginner's key limits the Segway's top speed, among other things.

It is envisaged that in the future users will be able to customise their operating parameters via programmable keys.

User display

Next to the key slot on the 'handlebar' is an LCD display which provides the user with all relevant information such as battery charge level and current operating conditions.

This display is designed for ease of



Riding is said to be as easy as falling off a log! Lean forward and it goes forward. Lean back and it stops, then goes backward. Twist the handlebar one way and it turns that way. And vice versa.

visibility in high levels of sunlight.

Chassis Design

The chassis is constructed from aluminum, sealed from the atmosphere to protect the electronics inside. Aside from obviously providing somewhere to stand on and a case for the internals of the unit, the chassis has been designed to act as a heatsink for the complex assembly of gyroscopes, processor boards, motors and batteries.

According to the manufacturer's testing, the chassis can withstand an amazing seven tonnes of load.

Inertial Sensor Assembly

This subsystem is probably one of the most amazing of the entire device. Incorporated into the top rim of the chassis are hidden injection-moulded rubber diaphragms. When the user gets onto the unit the diaphragms deform towards the electronics below, engaging the self-balancing systems.

At this stage the unit is aware of the operator's presence and begins balancing the unit and the user upright. In fact, anything but the hardest shove to a Segway rider will not tip them.

The Inertial Sensor Assembly resides within the chassis, sandwiched by the motors to one side and the batteries to the other. The assembly consists of five aviation-grade gyroscopes, used to determine the location of the machine in relation to the Earth's gravitational field.

The design philosophy of the Segway has been to incorporate a very high level of redundancy into the device, which has been reflected though the use of five rather than the required three gyroscopes.

Each of the Segway's gyroscopes consists of a solid-state angular rate sensor, a device of silicon construction used to measure rotation.

This uses a tiny silicon wafer attached to a supporting structure. An AC voltage is applied to the wafer, causing it to vibrate in a predictable manner. When the device is moved, the vibration is altered and thus measured and used to determine the degree of rotation.

Electronics Controller Boards

The Segway uses dual, fully redundant controller boards to accept inputs from the Inertial Sensor Assembly, along with other sensors, in order to process the data and appropriately drive the motors. While Segway is very secretive regarding the architecture of these processor boards, they have reportedly claimed 10 onboard processors distributed amongst the two boards, with around three times the processing power of an average consumer PC. If either of the boards experiences a failure, the other board assumes control, and will bring the Segway to a safe stop.

Batteries

Probably the most conventional technology aboard the Segway are the rechargeable batteries, which are supplied in either Nickel Cadmium or Nickel Metal Hydride varieties.

According to early testing, fully charged Ni-MH batteries will be able to propel the Segway anywhere from 17km to 28km depending on the terrain, weight of the user, and method of riding.

Each Segway uses two batteries, which are sealed and incorporate charge and temperature monitoring electronics. The unit is charged from mains power and will take around six hours to fully charge.

Motors and Transmission

Each wheel is driven by two (redundant) high speed brushless electric motors. For each wheel, the motor consists of two windings, functioning as separate electric circuits, with full

redundancy, providing a single mechanical unit. In order to allow the motors to run at a high speed, which optimises efficiency, a 24:1 two stage helical sealed transmission unit is used in each wheel.

In addition to maximising efficiency, the beauty of the drive train design is the fact that by running the motors in opposite directions the unit is able to turn on the spot. This is a major selling feature of the Segway. In addition to this, the motors can propel the unit to a top speed of 20km/h, even with operators weighing up to 110kg.

The unit has no brakes as such, using the motors for accelerating, turning and braking. When the user signals his intent to slow or stop by leaning back, the control boards cause the motors to decelerate.

Wheels and Tyres

Each wheel is made from a forged steel hub surrounded by a glass-reinforced thermoplastic rim. Each rim has a cutaway hole for threading a bicycle-style lock through. The wheels attach to the main unit via a single nut mechanism.

In order to maximise the range of the unit, the wheels have special low-rolling-resistance silica tyres, which are air inflated and puncture resistant.

Synopsis

As the amazing array of technological features will surely attest, the Segway is indeed a machine which could go a long way towards being a personal transportation medium.

It does, however, come with a US$3000 price tag (AU$6000) for the yet-to-be-released consumer version and an astounding US$8,000 (AU $16,000) for the commercial model recently released.

But this has not deterred several US corporations, including the US Postal Service, The National Park Service and General Electric, amongst others, from signing on to field test the units over the next few years.

While all those involved with the Segway believe – or hope – it will become the next craze to sweep the world, one can not help but wonder why the average individual consumer would wish to spend almost half the price of a new small car on a device which is intended to replace one of life's most healthy activities – walking.

Depending on the success of the corporate trials, mass production for the consumer market could quite easily see the price fall to attainable levels.

Until then the Segway will remain a very expensive toy! **SC**

SEGWAY Specifications:

Top speed:	20km/h
Weight:	36kg
Dimensions:	48 x 63.5cm
Weight capacity:	110kg person with 34 kg of cargo
Range:	About 28km on even ground, or 17km on undulating terrain
Motors:	Each wheel is driven by a two horsepower brushless DC electric motor
Transmission:	Two-stage transmission with 24:1 gear ratio
Computer:	Two redundant processing boards with 10 processors distributed amongst them
Power:	Two rechargeable batteries. Either Ni-MH or Nicad
Sensors:	Five solid state gyroscopes plus sensors to detect presence of user
Brakes:	No mechanical braking system. Regenerative engine braking.
Turning radius:	On the spot
Security:	Intelligent Electronic Key system, using 128-bit encrypted key code. Also determines operational profile
Driver interface:	High visibility LCD display which indicates battery charge and operational status
Price:	Approx. US$3,000 (consumer version)

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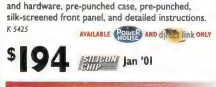

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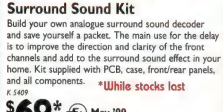

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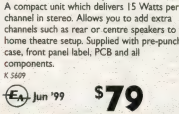

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T 2550

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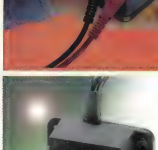

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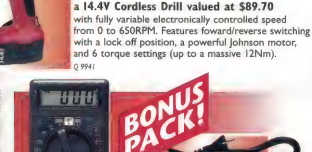
Power requirement: 200mA.

L 5843

$169

Swann COMMUNICATIONS



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Multimeter features a 3.5 digit (2000 count) LCD, Diode test, transistor test and low battery warning.

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Q 9901

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Camera specifications:

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L 5847

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H 4587

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H 9906

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Swapping hoses and pumps for electric motors and electronic control . . .

Electric Power Steering

By Julian Edgar

The conventional hydraulically-assisted power steering used in most cars is soon to be replaced with electric power steering. Already, many manufacturers are using electronically controlled hydraulic systems, while some car manufacturers have recently introduced purely electric systems to their mass production vehicles.

In addition to reducing parasitic loads, full electric power steering allows steering responsiveness to be automatically varied depending on speed, road conditions – and even the driver's ability!

Hydraulic Power-Assisted Steering

Hydraulic Power Assisted Steering (HYPAS) has been used in automotive applications for about 50 years. The systems use an engine-driven hydraulic pump, a control valve, steering cylinder and connecting hydraulic hoses. The pump is usually of a vane design with an integrated internal bypass. It is sized so that, even at idle rpm, it delivers enough oil flow to provide a suitable degree of power assistance.

The control valve uses a flexible torque-measuring device (such as a torsion bar, spiral spring or leaf spring) to convert the steering torque into a small control movement. This movement is transferred to a valve that regulates fluid flow to the power assistance mechanism.

In rack and pinion steering, a double-ended hydraulic ram mounted parallel to the rack (within the rack assembly) is used, while recirculating ball systems incorporate the mechanism into the steering box. Fig. 1 shows an example of a traditional HYPAS recirculating ball steering system. Note that in this particular system, the fluid reservoir is incorporated into the pump.

A major problem with simple HYPAS systems is that the assistance level is not reduced at high speeds, resulting in a lack of steering feel. American cars of the 1950s and 1960s were particularly noteworthy for their feather-light steering effort during parking, a trait which resulted in extreme vagueness at high speeds.

To overcome this problem, most HYPAS systems of the last few decades have incorporated mechanisms that reduce steering assistance, either as engine speed increases or (less frequently) as road speed increases. The reason that engine speed was more commonly used as the control parameter to reduce steering effort is that such a system can remain purely hydraulic, whereas using road speed as the control variable requires the use of an electronic system.

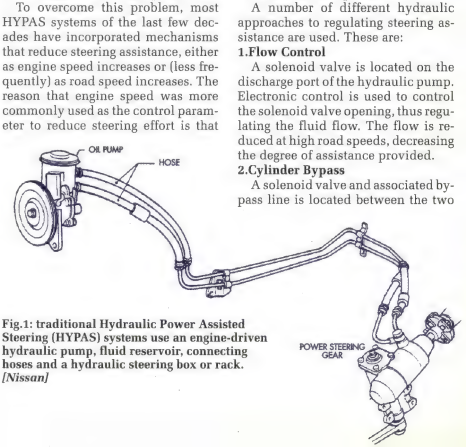


Fig.1: traditional Hydraulic Power Assisted Steering (HYPAS) systems use an engine-driven hydraulic pump, fluid reservoir, connecting hoses and a hydraulic steering box or rack. *[Nissan]*

Electronically-Controlled HYPAS

The introduction of electronic speedometers – and subsequently, full engine management – meant that an electronic road speed signal became available, allowing the widespread use of electronically-controlled HYPAS systems. These vary steering effort depending on road speed and also, in some cases, other parameters.

A number of different hydraulic approaches to regulating steering assistance are used. These are:

1.Flow Control

A solenoid valve is located on the discharge port of the hydraulic pump. Electronic control is used to control the solenoid valve opening, thus regulating the fluid flow. The flow is reduced at high road speeds, decreasing the degree of assistance provided.

2.Cylinder Bypass

A solenoid valve and associated bypass line is located between the two

chambers of the hydraulic cylinder, allowing a reduction of the pressure differential. The solenoid valve opening is controlled electronically, its opening greater at high road speeds. This reduces the degree of assistance that is provided.

3.Hydraulic Reaction Force

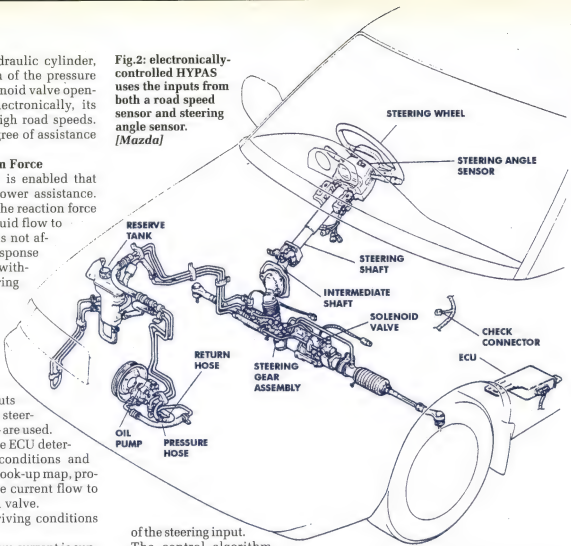
A hydraulic force is enabled that works against the power assistance. As speed increases, the reaction force is increased. Since fluid flow to the power cylinder is not affected, the steering response rate can remain high without reductions occurring in feel.

In their electronically-controlled HYPAS system, Hyundai use an ECU equipped with an 8-bit microprocessor. Two major inputs – vehicle speed and steering angular velocity – are used. From these inputs the ECU determines the driving conditions and via a 3-dimensional look-up map, provides the appropriate current flow to a hydraulic solenoid valve.

Three different driving conditions are recognised:

- **Parking** – maximum current is supplied to the solenoid valve, resulting in maximum steering assistance.
- **High Speed** – minimum current is supplied to the solenoid valve, resulting in minimum steering assistance.
- **Evasive Steering** – a large and sudden steering input causes the ECU to supply a current to the solenoid proportional to the angular velocity of the steering input.

Fig.2: electronically-controlled HYPAS uses the inputs from both a road speed sensor and steering angle sensor. *[Mazda]*



The control algorithm used in the system is as follows:

$I_S = I_V + I_{AW} + I_A + I_T$, where

I_S = Solenoid actuating current

I_V = Current according to vehicle speed

I_{AW} = Current according to steering angle velocity

I_A = Current according to steering angle

I_T = Current according to time

The purpose of I_A is to prevent the driver from experiencing an excessive steering holding force on banked roads. This current is increased in proportion to steering input angle. I_T provides additional assistance in situations where the vehicle enters a corner that follows a long straight driven at high speed.

Fig.2 shows the layout of a Mazda

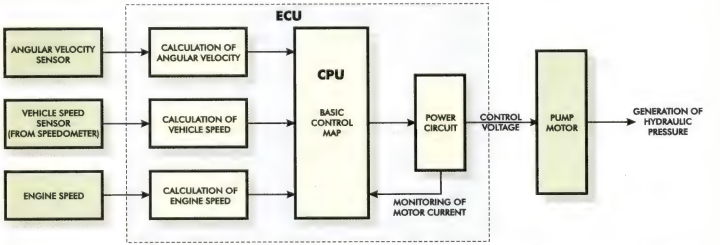


Fig.3: a schematic diagram of a Honda hybrid HYPAS control system. The hydraulic pump speed is controlled on the basis of inputs from steering wheel movement and engine and road speed. ***[Automotive Electronics Handbook]***

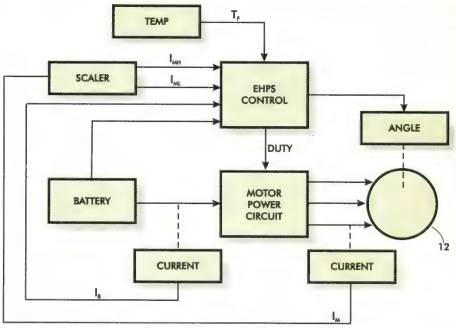


Fig.4: this General Motors hybrid HYPAS system senses motor current to determine the actual steering loads and so the degree of assistance that needs to be provided. The 3-phase brushless DC motor (12) is supplied power by the Motor Power Circuit. The EHPS control provides a duty cycle control to the Motor Power Circuit in response to input signals from the motor angle sensor, motor current sensor and battery current sensor, as well as operating system voltage. The temperature of the hydraulic fluid is also measured. The scaler is used on the motor current input to allow high resolution at low values without requiring a more costly A/D converter. ***[General Motors Corporation]***

HYPAS system where the degree of assistance is based on road speed and steering angle.

Hybrid Hydraulic/Electric Power Steering Systems

Hybrid HYPAS systems use an electric motor to drive the hydraulic pump, rather than having the pump driven directly by the engine. This approach allows the steering effort to be easily controlled by varying the pump speed. While the efficiency of such an approach is actually lower than a conventional belt-driven pump, because flow can be better matched to actual requirements, the overall parasitic power loss is reduced. Fuel economy savings of up to 0.2 litres/100 km are claimed to be possible by taking this approach.

The control approach that is taken can be of three types:

- **Driving Mode** – where driving conditions (such as city, country, highway, etc) are automatically judged with appropriate levels of assistance then provided;
- **Steering Wheel Input Mode** – where the angular velocity of the steering wheel movement is used to determine the degree of assistance required.
- **Steering Load Mode** – where demand for power assistance is indicated by the counter-pressure of the hydraulic fluid, sensed through variations in the motor current load.

Fig.3 shows the processes followed in one Steering Wheel Input Mode system to calculate the appropriate degree of assistance, while Fig.4 shows a schematic diagram of a control system that uses the Steering Load Mode.

Features	Benefits
Engine independence	Reduced engine power drain Improved fuel economy and acceleration Instant-on power steering Assistance available even should the engine stall
Elimination of pump, hoses, fluid, drivebelt and pulley	Simplified packaging Environmental compatibility Reduced mass
Modular design and integrated controller	Reduced assembly time Design and packaging flexibility
Multi vehicle use	Design and packaging flexibility
Software tuning	Wide assistance range In-vehicle laptop PC tuning Tuning process reduced from months to hours
Cost-effective advanced features	Variable effort steering Assisted return to centre Steering damping capability

Fig.5: some of the possible benefits of using Electric Power-Assisted Steering (EPAS) systems in place of traditional hydraulic power steering. ***[Delphi]***

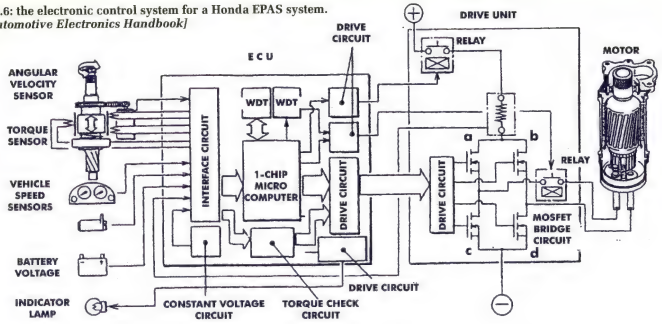
Electric Power-Assisted Steering

Electric Power-Assisted Steering (EPAS) completely replaces the hydraulic system that hitherto has always been associated with power steering. EPAS systems assist driver effort by the use of an electric motor which acts through a reversible gearbox and also, in some cases, an electromagnetic clutch. An electronic control unit determines the degree of assistance that is rendered.

EPAS has some significant advantages over any form of HYPAS, both for the owner of the car and its manufacturer. The reduction in engine load of an EPAS system (it can be as low as 4W when the car is being driven in a straight line) means that the fuel economy of a car equipped with EPAS is very similar to that of a car with no form of power steering.

Analyses provided by manufacturers of EPAS systems indicate poten-

Fig.6: the electronic control system for a Honda EPAS system. *[Automotive Electronics Handbook]*



tial fuel savings of 4-8 per cent over cars equipped with conventional HYPAS, with the lighter mass of an EPAS also having an impact. The independence of the system from engine operation also means that should the engine stall, steering assistance does not vary.

(In a conventional HYPAS system, a stalled engine immediately reduces steering assistance to zero – a problem if this occurs part way around a tightening corner!)

From a manufacturer's perspective, it has cost benefits. Using EPAS reduces assembly line time, allows easy software tuning of the steering assistance characteristics to suit a variety of cars (eg, a sports car or a limousine) and has the potential to improve reliability – 53% of all power steering warranty claims are from pump and hose problems.

Environmental gains are also possible from the decreased production and disposal of hydraulic fluid (worldwide, an estimated 40 million litres of power steering fluid was in use in 1995) and from the decreased requirement for the non-recyclable polymers used in hydraulic hoses.

Fig.5 shows the range of benefits potentially realisable from EPAS.

A number of EPAS systems are currently in production or in the final stages of prototyping.

The LucasVarity system uses a brushless DC servo motor and gearbox to develop a torque that varies

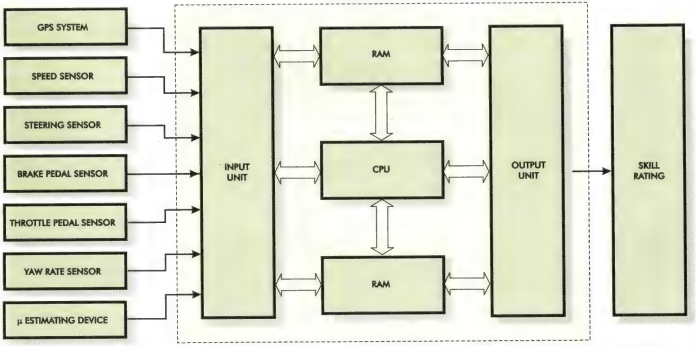


Fig.7: a recently patented Honda EPAS system actively calculates the driver's ability and provides steering feel and weight to match. Inputs to this system can include GPS navigation and yaw rate information, with the system comparing the actual path taken by the vehicle with its computed target trajectory. ***[Honda]***

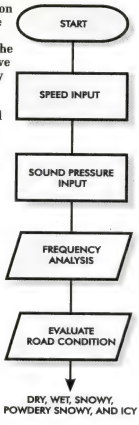


Fig.8: calculation of the available road friction is carried out in the the Honda active EPAS system by spectrum-analysing the noise generated by the tyres on the road! *[Honda]*

from about 15Nm in a small car to 75Nm in a large sedan. Other manufacturers, such as TRW, use variable reluctance motor designs. The electric motor that is used requires low levels or ripple and "cogging".

LucasVarity achieve this by using a three-phase inverter to vary motor phase currents and so torque. Power mosfets are used to control the switching and pulse width modulation techniques are used.

Depending on the location of the electric assist unit, drive can be transmitted to the steering mechanism by a number of means. These are shown in the table of Fig.9.

In the LucasVarity system, a dual-channel optical device is used to sense steering input torque. Two optical discs are mounted 50mm apart at either end of a torsion bar, which is incorporated into the steering shaft. Torque applied to the steering wheel causes a relative movement of the two discs, with the angular offset optically sensed.

Comparison of the two output signals allows the calculation of steering torque, steering wheel angular velocity, and steering angle. Anther torque sensor that can be used incorporates LVDT (linear variable differential transformer) techniques, with the twist of a torsion bar converted to a slider displacement. Other system inputs include vehicle speed and battery voltage.

Fig.6 shows the schematic diagram of a Honda EPAS system.

Driver Skill Estimation!

One of the most interesting aspects of EPAS is the ability that the manufacturer has to 'tune' the system's responsiveness. As indicated earlier, this allows the easy software matching of a single EPAS to applications as diverse as a two-seater sports car or luxury sedan but it also means that system responsiveness can be made to vary in different driving situations in the one car.

When this approach is taken, the input by the driver of a certain amount of steering lock does not always result in the same degree of assistance – should the ECU determine that such a steering movement is not appropriate for the conditions that the vehicle is undergoing, the steering assistance may be reduced or the steering input even actively resisted!

As an indication of the far-reaching implications of this, Honda has very recently developed an EPAS system that estimates the skill of the driver and provides steering assistance to match.

In the Honda system, a 'driver skill estimation device' is used, as shown in Fig.7. This device has inputs from:

- a GPS system(!);
- a vehicle speed sensor;
- a steering sensor that provides information on steering angular speed, angular acceleration and torque input;
- a brake pedal sensor that detects braking stroke, speed and force;
- a throttle pedal sensor that detects accelerator stroke and speed;
- a yaw rate sensor;
- a road friction estimate input.

The road friction estimate is determined by yet another system, with the approach taken shown in Fig.8. Vehicle speed and a sound pressure signal are gained from appropriate sensors, with an audio frequency analysis of this data then undertaken to determine whether the road is dry, wet, snowy, powdery snow or icy.

(Note that while the GPS and yaw rate inputs are included in the Honda patent of the system, Honda state that the system can still work effectively without them.)

The 'driver skill estimation device' analyses the actual path taken by the vehicle and compares this with a computed target trajectory.

Using this and data on the vehicle wheelbase, the distance that the front and rear wheels are from the vehicle centre of gravity and other factors, the system awards the driver an ability that varies on five levels from "very poor" to "very good".

A very good driver is rewarded with very little steering force resistance (the driver gets what he or she asks for), while a poor driver will encounter steering that actively does not allow major steering inputs to be made at high speed.

According to Honda, this allows the skilled driver to "positively control the turning behaviour of the vehicle so as to briskly manoeuvre the vehicle.

Conversely, if the vehicle operator is not skilled, the control system produces a reaction which prevents the vehicle operator from over-reacting to the vehicle response, and [so] stabilises the vehicle."

One wonders what happens when a 'very poor' driver suddenly needs to swerve around a child that runs out onto the road. . . That they are a poor driver becomes a self-fulfilling prophecy, perhaps?

However, the Honda system does provide a very strong indication of the direction that EPAS systems can be expected to follow in the future. **SC**

Method	Electric Assist Unit Location	Power Transmission
Pinion assist	Under the dashboard on the steering column	Motor > worm gear > column shaft > pinion shaft
	On the steering rack input pinion	Motor > gear train > pinion shaft
Rack assist	On the steering rack	Motor > ball screw > rack shaft
	On a second pinion on the steering rack	Motor > planetary geartrain > another shaft pinion > rack shaft

Fig.9: electric assist units can transmit drive in a variety of ways, depending on their physical location in the vehicle.

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FAQs On The MP3 Jukebox Player

The MP3 Jukebox player featured in the September & October 2001 issues has been very successful and already several hundred have been built and are operating. However, as with any project, questions frequently arise. Here are some of the questions, together with their answers.

Saving Playlist Files

Q I have just purchased and built the MP3 Jukebox kit from Altronics. I found it worked better than I expected but the only problem is that I am only able to load one playlist and play from that. Can you please tell me what I am doing wrong?

I have about 1000 MP3s on their own hard drive (F), broken up into about 25 different categories. I have created some Winamp playlists and put them in each directory (ie, F:\80s\80s.m3u). Also, I have tried putting all the playlists in F drive (ie, F:\80s.m3u). I cannot load another playlist using the remote control. I have set up the remote control as you suggested on page 31 of the October 2001 issue. What am I doing wrong or is it the software?

A Playlist (.M3U) files must be saved in the same directory as the MP3 files that they list.

Each entry in a .M3U file must contain only the filename, not the full pathname. For example, the full pathname to a track might be "F:\80s\MySong.MP3" but the entry for this track in the .M3U file should be only "MySong.MP3".

You don't mention anything about having created a metalist. Following the instructions in the article, create a metalist that contains the full pathname to each of your .M3U files. You can save the metalist file anywhere. Remember to define the path to the metalist in IR Remote Setup, selecting the "metalist" option.

What Are The Hardware Requirements?

Q Before beginning to build the MP3 Jukebox I am wondering about some modifications. I have a Gigabyte GA-6WMMC7 board, 10 months old, with an Intel 810 chipset, capable of up to 512MB of RAM and up to PIII processors. As I understand it, the player would not be multi-tasking, merely running a modified version of Winamp. As such, what is the minimum memory I should use and minimum processor speed to have a reliable player?

Also, I am sure that this board is capable of "soft-power". Is this the mode that the player goes into after shutdown or is the system halted?

As the 810 chipset has integrated sound and video, would it be advisable to put a cable from the player to a switchbox and then to my desktop PC to be able to make modifications to the player? Could I then use my keyboard, mouse and monitor to change settings on the player via a switchbox?

Finally, I have at my disposal a 20GB Seagate drive that I was planning on using for the drive in the player. As I have only 4-5GB of MP3s so far, I was planning on installing a network card so as I could rip MP3s and transfer them to the player, and also use the player's drive as a secondary storage device; ie, storing little-used data files. Also, using the player to store all my MP3s would free up space on my existing drive. Is this possible?

A We talked about PC requirements in the second article. Briefly, we think the minimum requirements would be a P133 (or equivalent) processor with about 32MB of memory.

Currently, the software performs a "hard" rather than "soft" power down.

Yes, you could use a switchbox. This is quite a good way to do it but your networked idea is even better. Once set up, you will rarely need to modify the software configuration.

Note that we use a completely standard (unmodified) version of Winamp. Although our Jukebox software is standalone, it controls Winamp in the same way that plug-ins do – via Windows IPCs. If you'd like to know more about Winamp's programming interface, check out the Developer pages at **www.winamp.com**

Doing Without The LCD Screen

Q The MP3 Jukebox seems great. I've having a great time playing around with it. Just a quick question though – could you release the source code for your IR program that controls Winamp? And second, will the module work without the LCD screen?

A Yes, you can use the IR Remote Receiver & LCD module without the LCD screen (no changes are needed) – just don't plug it in.

The VB code is probably not a great example if you're looking for inspiration but this is a link to it anyway:

http://www.siliconchip.com.au/software/Oct01/IRRemote VB6 Project.zip

Doing Without The Remote

Q I just made up the MP3 Jukeboox and the unit powers up and works fine with Hyperterminal. However, are there any manual entries I can make in the IRRemote/keycode registry keys to get the program to perform without the IR section as I have not yet got a remote and do not wish to buy one just now. Could you tell me the format for these keys?

I tried default settings of 53 for play and 54 for stop but I always get a loading registry settings (run setup) error.

A The following file contains all the key codes for a BC3000 remote (as featured in the article). Type it into Notepad as a text file and then rename it BC3000.reg. Then just double-click on it to load the codes into the registry.

```
REGEDIT4
[HKEY_CURRENT_USER\Software\VB and VBA Program Settings\IRRemote]
[HKEY_CURRENT_USER\Software\VB and VBA Program Settings\IRRemote\Key Codes]
"Play"="53"
"Pause"="48"
"Stop"="54"
"Fade Out"="55"
"Prev"="33"
"Next"="32"
"Back 5 Secs"="50"
"Fwd 5 Secs"="52"
"Volume Up"="16"
"Volume Down"="17"
"Repeat"="10"
"Shuffle"="35"
"Shift"="39"
[HKEY_CURRENT_USER\Software\VB and VBA Program Settings\IRRemote\Shift Codes]
"Load Playlist"="53"
"Reload Playlist"="54"
"Prev Playlist"="33"
"Next Playlist"="32"
"Close Winamp"="55"
"Shut Down PC"="12"
"Toggle Equaliser"="35"
"Set Equaliser"="10"
[HKEY_CURRENT_USER\Software\VB and VBA Program Settings\IRRemote\System]
"Address"="5"
```

What About The Windows Media Player?

Q I'm intrigued by the MP3 Jukebox. I was wondering whether it is possible to use the same system/program with other media playing programs? Is it only limited to Winamp? Is it at all possible to use this setup with Windows Media Player, mainly taking control of the volume, play and pause? I'd be using the standard media player with Windows 2000.

A The IR Remote software is designed to work with Winamp only. However, if you have some VB6 or C++ programming experience, you could write a program using the hardware part of the project (the IR Remote Receiver & LCD Display) to control Windows Media Player.

Microsoft provide an ActiveX control for Media Player – check out what's available at: **http://www.microsoft.com/windows/windowsmedia/default.asp**

For an example of how to use the Media Player ActiveX control, see **http://www.elementkjournals.com/ivb/0011/ivb00b1.htm**

The IR Remote Receiver & Display (hardware) part of the project is entirely suitable for use with Windows Media Player in conjunction with suitable software.

Windows Media Player updates are available from:
http://www.microsoft.com/windows/windowsmedia/download/default.asp

Using Playlists

Q I've built the MP3 Jukebox kit (and everything works fine), programmed the Altronics A-1007 Universal Remote and catalogued over 160 music CDs! Finally, I found time to try the system together and everything seems OK.

However, I found that if you are playing a song and you want to listen either to another song or playlist, the music currently playing stops immediately and it starts to play the next selection; even if the song has only just started.

Is this how the system is supposed to operate? I would have thought that like a proper jukebox (like the ones you can hire), this one would also continue to play the current selection before proceeding to the next track/playlist. Winamp by default works in this way but through this kit and using the remote control, Winamp doesn't seem to "buffer" the tracks.

A This is how it is designed to work. Your only option really is to sort the tracks in the playlists in the order you would like to hear them.

It probably wouldn't be too difficult for an experienced VB6 programmer to alter the IR Remote program to do what you want. The source code can be downloaded from **http://www.siliconchip.com.au/software/Oct01/IRRemote VB6 Project.zip**

Substituting A Slower Crystal

Q Could you please advise if there are any implications with using the 10MHz version of the Atmel AVR Microcontroller in the IR & LCD MP3 Jukebox project?

A There are no problems using the 10MHz part with a 4MHz crystal as used in the project. We used a 10MHz micro in the prototype because although 4MHz parts are cheaper, they're harder to obtain.

TOUCH and/or REMOTE-CONTROLLED LIGHT DIMMER

By John Clarke

Old-fashioned light dimmers with their knobs on the architrave are so passé! Here's one that you simply touch to dim up or down, or touch again to turn full on or full off. Not decadent enough? How about full remote control from the comfort of your armchair? Now that's a dimmer!

Every now and then we get a letter or email criticising our use of a microcontroller when (perhaps) a similar job could have been done with (lots of!) discrete components.

Well, look at our latest light dimmer – and what it does. We make no apologies for using a PIC because it does so much, so simply. A project such as this demonstrates perfectly why we use microcontrollers.

There would be very few homes that don't have a light dimmer or three. So-called "mood lighting" became the big thing in the eighties; today light dimmers are installed in living rooms, lounge rooms, bedrooms – in fact, just about anywhere.

But the traditional wall-mounted, knob-controlled light dimmer has a major drawback. You decide you want to dim the lights and you have to get up out of your comfy chair and go and do it. Wouldn't it be nice if you could do it by remote control?

You can with the all-new SILICON CHIP light dimmer. What's more, there's no ugly knob. There's not even a light switch!

As well as using a remote control, you can actuate the dimmer – up or down – by simply touching an attractive plate which takes the place of the light switch and knob. And you can add one or more extensions for two, three or more-way dimming.

The dimmer itself is very sleek. The only part that you see when mounted onto a wall is a modern aluminium wallplate (we used a commercially-available Clipsal Classic 2000 blank plate – so it looks very professional and as modern as tomorrow.

A "window" is added to allow for reception of the remote control infrared transmission from the hand-held unit.

You don't even have to build the infrared controller yourself: it is a low-cost, commercially available unit which is preprogrammed for hundreds of different types of TVs, VCRs, satellite receivers, etc.

The light dimmer can be set to operate on one of four programming codes so you can select one which does not operate any of your other devices. (You'd hardly want the telly to change volume whenever you dimmed the lights!).

We have tested two different hand-held remote controls. One is a simple TV-only unit with minimal controls while the second is more elaborate and can control several different devices. This could also be used to control your TV set and VCR as well as the light dimmer.

Hey, we've just helped you get rid of a couple of remote controls!

Dimming and "soft starting"

As mentioned, dimming of the lights can be achieved in two ways: using the touch plate or using the remote control. We'll look at the touch plate first.

Dimming is initiated by simply holding your hand on the touch plate and the light will be dimmed either up or down. It takes just on three seconds for the light to be dimmed over its full range. Dimming stops when either minimum brightness or full brightness is reached.

Dimming the light in the opposite direction simply requires the hand to be momentarily removed from the touch plate and then reapplied.

Want instant light? A quick tap of the touch plate will switch the light on and another quick tap will turn it off. When switching on, the lamp is returned to the brightness that it was last dimmed to.

If you want the lamp at full brightness, you can give the touch plate another quick touch and the lamp will be brought up to full brightness. This second touch must be done within 2.5 seconds or the lamp will be switched off instead. Alternatively, you can hold your hand on the plate so that it is dimmed up to the required brightness.

Even when apparently switching on instantly, the lamp is always "soft started" to reduce stress on the lamp filament. What this means is that power is applied to the lamp gradually to bring it up to brightness.

When you turn on a normal light, a very high surge current flows for a brief period (until the cold filament heats up). This causes a thermal shock which can cause the filament to break – especially when the lamp is reaching the end of its life. You have probably noticed that the vast majority of lamps "blow" at the instant they are turned on.

Allowing the lamp to warm up slowly, with soft starting, prevents the filament from changing from cold to hot too quickly, reducing the thermal shock. Even though it happens slowly as far as the filament is concerned, as far as you (the user) are concerned it all happens pretty quickly. The soft start brings the brightness of the lamp up automatically from minimum brightness to full brightness in just 340ms. Therefore it takes 17 mains cycles (50Hz) for the lamp to be at full brightness.

Soft starting occurs whether the lamp is only brought up to a low brightness setting or to full brightness. Normal up/down dimming also effectively provides a soft start because of its slower change in brightness over time.

Features

- Attractive slimline appearance - no knobs!
- Touch Plate dimming
- Soft start for lamp when switched on
- Last dimming setting stored and returned at switch on
- Full brightness restored on second touch
- Remote control operation
- Full control features with Touch Plate extension
- RFI suppression
- Reset for brownout and blackout

Remote control

Remote control features are different to those available with the touch plate. The touch plate has effectively only one control – a touch – which must perform several functions but the remote hand-held unit has several controls. So we can use different buttons to perform various dimming functions.

We have selected five buttons to do the job. The 'CH +' and 'CH –' buttons provide fast up and down dimming respectively. The 'volume +' and 'volume –' buttons provide for slow up and down dimming. The 'mute' button turns off the lights.

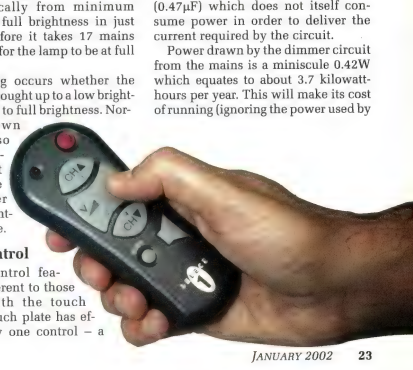
Incidentally, fast dimming takes two seconds from one lamp brightness extreme to the other, while slow up and down dimming takes 11.6 seconds. You can use the fast controls to set the approximate brightness required and the slow dimming buttons to more accurately set the level.

There are 102 brightness levels available from minimum brightness to full brightness and the brightness is varied so that its level appears to change in approximately equal steps.

When the light dimmer is first installed or if power is restored after a blackout or brownout, the lamp is initially set as off. Full brightness is returned with a quick touch of the dimmer plate. Also the last dimmed level is not remembered when the power is lost.

The dimmer is powered from the mains via a dropping capacitor (0.47µF) which does not itself consume power in order to deliver the current required by the circuit.

Power drawn by the dimmer circuit from the mains is a miniscule 0.42W which equates to about 3.7 kilowatt-hours per year. This will make its cost of running (ignoring the power used by



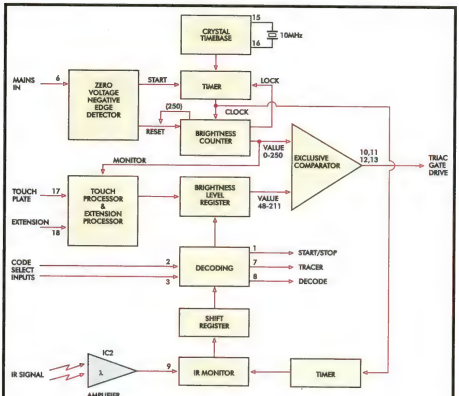


Fig.1: there appears to be a lot in the dimmer but most of the work is undertaken by the PIC microcontroller, IC1, which comprises the yellow blocks.

the lamp) less than 40 cents per year.

Phase controlled dimming

The dimming circuitry is based on phase control to set the lamp brightness.

As you know, our electricity supply (nominally 240V AC) is a 50Hz sinewave which goes positive for 10ms, back through zero and negative for 10ms, back through zero and positive for 10ms, and so on.

Normally, of course, the lamp filament is connected to the supply when ever it is switched on. But what if it could be switched on and off very rapidly, so that only a percentage of the mains voltage could get through? If it was connected 50% of the time, you would expect the lamp to be significantly dimmer than when connected 100% of the time.

Now what if this on/off switching was so accurately timed that the "on" point occurred at the same point in each half cycle (say half way through, or 50%) and the "off" point occurred at the end of that half cycle? The effect would be exactly the same.

That is effectively what a phase controlled Triac dimmer does. It allows power to get to the lamp only for certain portions of the mains cycle. If power is connected early in the cycle, the lamp will glow brighter. But if it is connected much later in the cycle, the lamp will glow much dimmer, simply because there isn't the power to heat the filament as much.

Switching is performed by a device known as a Triac which can be triggered on by a voltage at its gate. The Triac will only turn off when current through it drops below a certain threshold value. In practice, when driving a resistive load, this means that the Triac switches off when the mains voltage is near 0V. The accompanying oscilloscope traces show how it works.

The first oscilloscope waveform (Scope 1) is the 50Hz mains sinusuoidal voltage measured on the active output of a power point. This has an effective or RMS voltage of 240V (±5%) while the peak voltage is about 339V. Note that the mains voltage shown here is higher – 250VAC and 355V peak (half the peak-to-peak voltage).

The second oscilloscope screen (Scope 2) shows the waveform applied to the lamp when it is required to have a low brightness. In this case, the lamp is powered about 150° from the start of each mains half cycle and is switched off at 0V. The lamp voltage is applied for both positive and negative excursions of the mains and the RMS voltage is around 39V.

The next oscilloscope waveform (Scope 3) show the lamp voltage when it is bright. Now the voltage is applied early in each mains half cycle so that almost the full mains waveform is applied. Again the lamp is switched off at 0V. The RMS voltage is now a lot higher at 242V.

Circuitry for the lamp dimmer utilises this phase control by dividing up each half of the mains waveform into 250 discrete sections. There are 250 sections starting from the 0° and finishing at 180° for the positive half cycle and another 250 discrete sections from 180° through to 360° for the negative half cycle. Thus each discrete section of the mains is about 0.72° (180/250). This is shown in Fig.2. A count of 48 is therefore 34° and a count of 211 is 152°. These are the two extremes over which the circuit will dim the lights.

Block diagram

Fig.1 shows the general arrangement

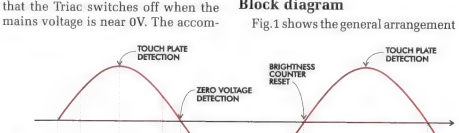
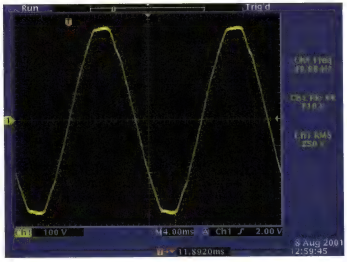
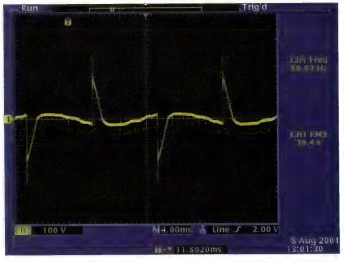
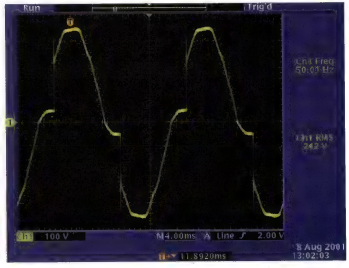


Fig.2: this diagram represents 1.5 cycles (30ms) of mains voltage. The degrees and brightness counter scales are explained in the text.







These three oscillograms show how phase control delivers various amounts of power to a load. On the left (Scope1) is a somewhat distorted sine wave, straight out of a power point. While nominally 240V AC, 50Hz, in this case it's actually 250V AC and the frequency is just a tad low (neither of which is unusual). The second shot (Scope 2, above right) shows power being made available to the load very late in the half cycle so it effectively receives just under 40V. In this case, the lamp would be barely glowing. Scope 3, the waveform at right, shows triggering very much earlier in the cycle, so the lamp receives almost all the available power. Here the lamp would be at virtually full brilliance.

WARNING: These scope waveforms are shown to explain the operation of the circuit. DO NOT try to reproduce these waveforms yourself – it is too dangerous. We used a special low-voltage test jig to obtain some of these waveforms.

of the dimmer circuit. Most of the operation, with the exception of the infrared amplifier demodulator (IC2), is performed by IC1, a single chip microcontroller. We used a PIC16F84-10/P (or PIC16F84A-20/P), programmed to perform phase control. It accepts inputs from the mains, from the touch plate and external terminal and also from the remote control amplifier demodulator (IC2). It then provides an output to drive a Triac.

The mains input at pin 6 of IC1 provides information about the phase of the waveform. Each time the voltage passes through zero (see Fig.2) the zero crossing detector resets the brightness counter. This counts from 0 through to 250 for both the 10ms positive and the 10ms negative half cycles of the mains voltage. It counts up every 40µs provided by a signal from an internal timer which is clocked using a 10MHz crystal timebase.

An important part of this circuit is the feedback from the brightness counter back to the internal timer. This is required to lock the internal timer to the brightness counter.

Any deviation from this locked arrangement will produce flickering in the phase controlled lamp. Without locking, the counter could be any value between 225 to 275 depending on the mains frequency and crystal frequency drift.

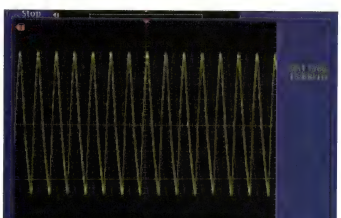
We therefore lock the counter to the mains by adjusting the internal timer in increments of 800ns either faster or slower over the 10ms period between each zero crossing. Adjustments are carried out every 20ms.

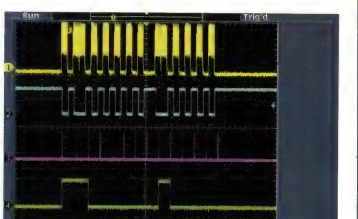
Inputs from the touch plate (and extension, if fitted) are monitored by the touch processing block. Touch plate detection is checked at around 90° which is the peak positive excursion of the mains waveform. The actual power supply for the dimmer follows the mains voltage and so if we want to pull pin 17 towards ground, the best sensitivity for this is when the dimmer circuit is sitting at the peak positive excursion of the mains waveform.

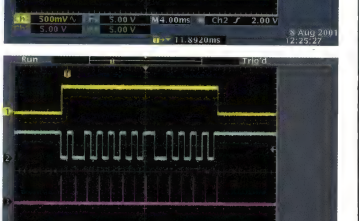
The touch processing determines how long the touch plate has been touched or how long the extension input is connected by counting the number of mains cycles. It processes this to control the brightness level register.

Similarly, the brightness level register is altered using the remote control. IC2 detects the infrared remote control code and amplifies the signal. Its output provides a demodulated signal of the transmitted code. Oscilloscope traces show the signal from the infrared hand held unit which is a modulated signal on a 36kHz carrier (Scope 4). The second set of traces (Scope 5) show this modulated signal in channel 1. Channel 2 shows the demodulated signal at the output of IC2 where the carrier is removed. Note that IC2 inverts the remote control signal.

The remote control signal at the output of IC2 is applied to pin 9 of the infrared decode select block. A shift register







Scope 4, on the left, shows the signal from the infrared hand-held unit which is a modulated signal on a 36kHz carrier. Scope 5, top right, shows this modulated signal in channel 1 (the yellow waveform). Channel 2 (blue waveform) shows the demodulated signal at the output of IC2 where the carrier is removed. Channel 3 (magenta) is the tracer waveform, while the green waveform (Channel 4) shows the decoded output. Scope 6 (right) is similar to Scope 5 except that channel 1 (yellow) shows the stop start waveform. This signal can be used to sync the oscilloscope.

converts the remote control serial code into a parallel form suitable for comparing with the known control codes in the decoder.

Remote control operation codes are shown at pins 1, 7 & 8 which give the start and stop signal for the remote control signal, the tracer output which shows the position where the level of the remote control signal is read and the final decoded signal as applied to the decoder. Channels 2, 3 and 4 show this.

The remote control signal applied to pin 9 is a bi-phase code where a low level is represented by a high level going to a low level and a high is represented by a low level going to a high level.

Note how the tracer signal in channel 3 (short positive pulse) is essentially in the middle of the high or low square waveform of the remote control signal found at the pin 9 input at channel 2. Incorrect decoding will occur if the tracer rate is too fast or too slow, which will shift the tracer too far to the left or to the right respectively. The waveform resulting from the detection at the tracer points is the lower channel 4 output and is the decoded signal.

The Scope 6 waveforms are similar to those above except that we have included the stop start waveform for channel 1. This signal can be used to sync the oscilloscope.

Decoding periods are set by the internal timer which as previously mentioned is locked to the mains frequency. If the mains frequency drifts too far off 50Hz, then the remote control decoding will not operate correctly and will result in loss of remote control operation. Fortunately, the mains frequency is usually well within 5% of the nominal 50Hz and with this variation (47.5Hz to 52.5Hz) the remote control will still operate.

In fact, the mains frequency will be very, very close to 50Hz most of the time. This is because it must remain accurate for power stations to keep in lock with each other and also to maintain load conditions over time.

And if it varied too much, every mains-locked clock radio and alarm clock in the country would show the wrong time – and then wouldn't people get upset!

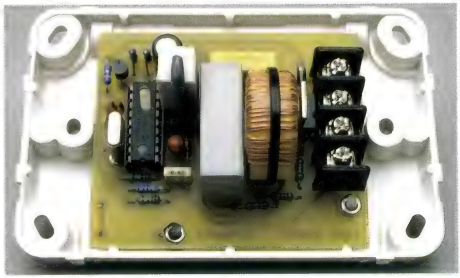
Once the remote control signal is decoded it is compared with stored codes. Inputs at pins 2 and 3 select the particular code that is used with four possible different codes available. When the selected stored code is the same as the received remote control signal the brightness level register is altered in response to the particular function delivered by the remote control. So, for example, if fast up dimming is selected, the brightness level register is decreased to increase lamp brightness.

The following comparator monitors both the brightness

PLEASE NOTE!

This circuit operates on the 240 volt mains and most parts of the circuit are at mains potential and therefore DANGEROUS. Furthermore, installation into fixed wiring can only be undertaken by licensed electricians under current legislation in most states.

The PC board is secured to the plastic face plate with nylon screws. The metal screw (bottom of pic) makes contact with the aluminium cover plate which acts as the touch sensor.



level register and the brightness counter. When they are equal, the comparator output provides a pulse to drive the Triac gate.

If the brightness level register is a low value, this value will be equal to the brightness counter early in the mains cycle to provide a bright lamp. If the brightness level register is a larger value, the value will be equal to the brightness counter later in the mains cycle and so the lamp will be dimmer.

The circuit

Considering the complexity of the dimmer operation, there is not too much in the actual circuit itself. This is because most of the work is done in the PIC16F84-10P microcontroller (IC1). Apart from this IC there is only the infrared decoder (IC2), a Triac, several diodes, a transistor, a crystal and an inductor plus a few resistors and capacitors .

The Triac is connected between the mains active and the lamp via an inductor (L1). This inductor, in conjunction with the 0.1µF 250VAC capacitor, provides suppression of electromagnetic radiation caused by the Triac switching. The inductor core is made from an iron powdered material which is very lossy in the high frequencies, particularly above 1MHz.

Power for the circuit is derived directly from the mains supply, using a 0.47µF 250VAC mains capacitor as a dropping impedance for the follow-

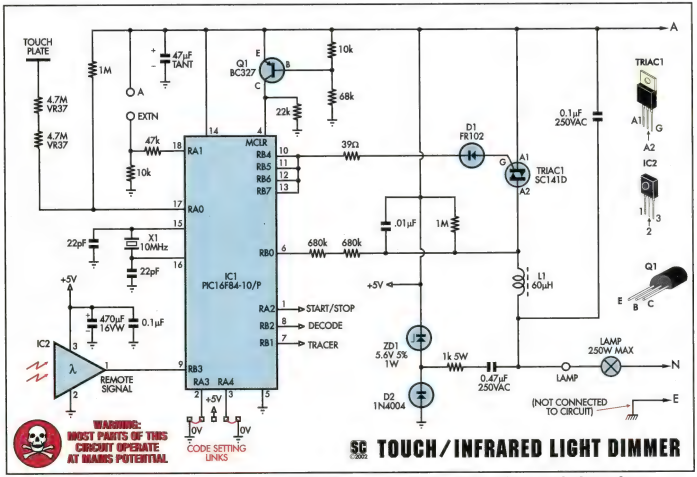


Fig.3: the circuit is based on a suitably programmed PIC 16F84. It can handle input from either a touch plate or from a selection of infrared remote controllers. The code setting links depend on the specific controller.

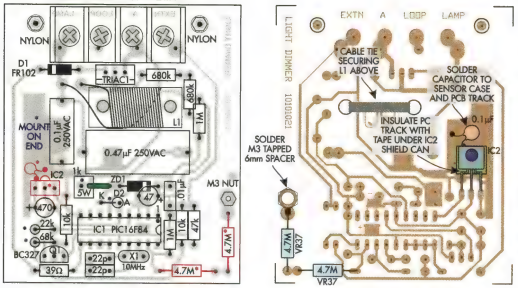


Fig.3: the PC board has tracks on one side but components are fitted to both sides. At left is the 'normal' component side while the right diagram shows the copper (track) side with the infrared receiver, capacitor and resistors.

ing 5.6V zener diode, ZD1. The 0.47µF capacitor has an impedance of 6.77kΩ at 50Hz. When combined with the series 1kΩ resistor this doesn't give an effective impedance of 7.77kΩ, as you might expect. It's actually 6.84kΩ due to the phase differences between the capacitor and the resistor. This impedance limits the current flow in ZD1 to 35mA.

The resulting supply is about 5V due to the voltage drop across D2.

One thing to note here is that this 5V power supply can only be obtained when the Triac is off. When the Triac is on there is only about 1V across it which is insufficient to develop the power supply voltage.

Thus the phase control is limited to a minimum of 35° to make sure that there will always be power available. This phase angle also sets the maximum brightness for the lamp. While it appears to be fully bright, it is not quite as bright as if switched directly across the mains supply.

If the 0.47µF capacitor gives an impedance of 6.77kΩ by itself, why include the 1kΩ resistor in series? One reason is to limit surge currents if the mains supply is connected during the peak of the supply. However, there is another and more important reason and is because of the Triac.

When the Triac is fired, the charge on the capacitor is immediately discharged through L1, the Triac, the zener diode and the 1kΩ resistor. So we need to limit this surge current through the zener diode, particularly when the capacitor is charged to 340V (the peak of the 240V AC waveform).

Dissipation in the 1kΩ resistor is another consideration. If the Triac is off, then the 0.47µF capacitor can charge and discharge smoothly with the sine wave voltage and the current through the 1kΩ resistor is about 35mA RMS. This gives a power dissipation in the 1kΩ resistor of 1.23W.

Things are different when the Triac is fired. This is because of the energy stored in the capacitor – 27mJ (½CV²). To convert this to watts we multiply by 100 as there are this many half cycles in a 50Hz mains waveform per second. The worst case dissipation then becomes 2.7W in the 1kΩ resistor.

Selection of the resistance value is a compromise between having low power dissipation when the Triac is off (which calls for a low value of resistance) and reducing the surge current through the zener diode when the Triac is fired (which calls for a large value of resistance).

The resulting DC supply is filtered with the 470µF electrolytic capacitor and 0.1µF ceramic capacitor for IC2 and the 47uF tantalum capacitor for IC1. The 0.1uF ceramic capacitor aids the 470µF capacitor in suppressing high frequency noise on IC2's supply which could cause erratic operation of this high gain device. The tantalum capacitor provides both high frequency filtering and also sufficient energy storage for the current drive to the Triac.

Power is applied between pins 14 and 5 of IC1 and between pins 3 and 2 of IC2. Pin 4 of IC1 is the reset input for the microcontroller and connects to the brownout circuit, comprising Q1 and the associated resistors. The

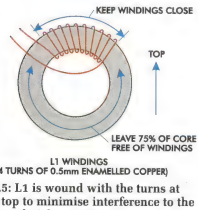


Fig.5: L1 is wound with the turns at the top to minimise interference to the infrared pickup circuit.

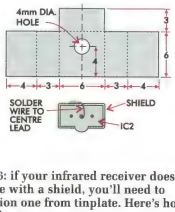
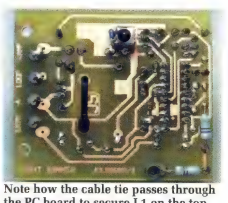


Fig.6: if your infrared receiver doesn't come with a shield, you'll need to fashion one from tinplate. Here's how it's done.



Note how the cable tie passes through the PC board to secure L1 on the top side.

circuit is used to bring pin 4 low if the supply drops below a certain threshold.

With a 5V supply, there is sufficient voltage on the base of Q1 to switch it on, pulling pin 4 to the 5V supply rail. If the supply rail drops, current through the 10kΩ and 68kΩ resistors at Q1s base will also fall. When the supply voltage reaches 4.68V, the current through the resistors is 60μA and so the voltage across the 10kΩ resistor is 0.6V. At this voltage Q1 just begins to turn off, pulling pin 4 of IC1 low to reset it.

Crystal X1 operates at 10MHz to provide IC1 with an accurate clock signal for all the timing signals required in the phase control driver and remote control decoder functions. The 22pF capacitors provide the crystal loading to ensure a reliable oscillation when power is applied.

Dimming control inputs are at pin 17 for the touch plate and at pin 18 for the extension. The touch plate is connected to pin 17 via two series-connected 4.7MΩ high voltage resistors. It is essential to use the resistors nominated (ie, Philips VR37). As well as limiting any current flow to a person touching the touch plate to below 26μA, these particular resistors give a good safety margin as they are rated at 2.5kV (AC) each. Two resistors increase the voltage rating to 5kV giving extra safety.

Normally, the input from the touch plate (pin 17) is held at 5V via the 1MΩ resistor but if the touch plate is touched, the ground capacitance of the person will bring the touch plate to ground potential. This effectively pulls pin 17 down to the same level as pin 5 whenever the active line is above ground. IC1 can then detect this low voltage.

The extension input at pin 18 is normally held low via the 10kΩ resistor. It is pulled high to the 5V supply, when the extension is activated (in the same way as the main touch plate above). The 47kΩ resistor to pin 18 is used to protect the input from transients or incorrect connections to the extension.

Note that we need to use this extension input for extra touch plates. If we simply extended the pin 17 input to another switch plate the extra capacitance and pickup from the extra line length would trigger this high impedance input.

The whole assembly fits into a standard mounting box (as shown here) or can be attached to a standard mounting plate. The brushed aluminium cover which goes over the whole assembly forms the touch plate.

IC2 receives and demodulates the codes from the infrared remote control. It incorporates an amplifier and automatic gain control plus a 38kHz bandpass filter to accept only remote control signals. It then detects and removes the 38kHz carrier. The resulting signal is applied to the pin 9 input of IC1 ready for code detection. The pin 2 and pin 3 inputs provide options for one of four remote control codes and are set by tying these pins either high or low with solder link connections.

The high gain of IC2 makes this device susceptible to electrical interference from the switching Triac and from the suppression components.

The software has been carefully planned so that the remote control coding is only monitored when interference is at a minimum. This interference, however, does cause the gain of the amplifier to be substantially reduced due to its internal automatic gain feature which is used to prevent overload in its circuitry. This throttling back of gain reduces the range of the remote control operation.

To minimise the effect, we have included shielding around the device and have wound the suppression inductor in an unusual manner to substantially reduce any electromagnetic radiation.

The zero voltage crossing point for the mains waveform is detected at pin 6 of IC1 via two series connected 680kΩ

Parts List – Touch/Remote Controlled Dimmer

1 PC board coded 10101021, 62 x 72mm
1 preprogrammed remote control
(Jaycar 'Big Shot 3' AR-1710) or
1-TV preprogrammed remote control
(Jaycar 'Select 1' AR-1703)
1 Clipsal CLIC2031VXBA blank plate and blank aluminium plate
1 15mm x 20mm piece 0.5mm clear or red acrylic
1 iron powdered toroidal inductor, 28 x 14 x 11mm (Jaycar LO-1244 or equivalent) (L1)
1 4-way PC screw terminal block (Altronics P 2103 or equivalent)
1 18-pin DIL socket
1 10MHz parallel resonant crystal (X1)
2 M3 x 16mm countersunk Nylon screws
1 M3 x 15mm countersunk plated metal screw
2 3mm x 6mm untapped spacers
1 M3 tapped x 6mm metal spacer
3 M3 nuts
1 150mm cable tie
1 1.2m length of 0.6mm enamelled copper wire
1 9 x 20mm piece of tinplate (tin can material)
1 50mm length of 1.5mm spaghetti tubing

Semiconductors

1 PIC16F84-10/P (or PIC16F84A-20/P) programmed with Dimmer.hex (IC1)
1 infrared receiver (Jaycar ZD-1952, DSE Z-1955 or equiv) (IC2)
1 SC141D 10A 600V Triac or similar (Triac1)
1 BC327 PNP transistor (Q1)
1 FR102 (UF102, 1N4936) or similar fast diode (D1)
1 1N4002 diode (D2)
1 BZV85C5V6 1.3W zener diode 5% (ZD1) (alternatives must be 5% tolerance)

Capacitors

1 470µF (105° C) 16VW PC electrolytic
1 47µF 16VW tantalum
1 0.47µF 250VAC X2 class MKT polyester
1 0.1µF 250VAC X2 class MKT polyester
1 0.1µF ceramic
1 0.01µF MKT polyester
2 22pF ceramic

Resistors (0.25W 1% unless stated.)

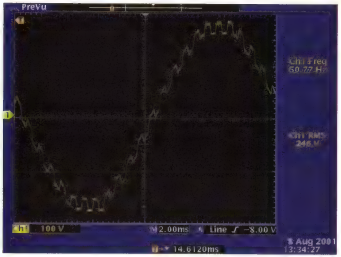
2 4.7MΩ VR37 Philips high voltage (no substitutes)

2 1MΩ	2 680kΩ	1 68kΩ	1 47kΩ
1 22kΩ	2 10kΩ	1 1kΩ 5W	1 39Ω

resistors connected to the A2 terminal of the Triac. Detection of the zero crossing is only made at the negative transition.

If the Triac switches on, the A2 terminal will cause the input to go high. So zero detection is only available when the A2 terminal goes low, at the end of the positive half cycle of the mains waveform. The zero voltage detection signal is also filtered with a .01µF filter capacitor.

This capacitor causes a substantial shift in the detected zero crossing point but this is adjusted in software so that the



Scope 7: this shows the mains waveform with a 1kHz control tone superimposed on it. The effective modulation is up to 50V peak-to-peak and can cause havoc in the zero voltage detection unless filtered out.

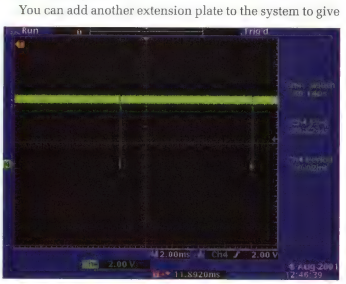
dimmer operates within the correct phase limits. The filtering is necessary to reduce the effects of electricity authority control tones which may be superimposed on the 50Hz mains. These could otherwise cause rather noticeable flickering in the lamp.

The Scope7 oscilloscope waveform shows the mains waveform with a 1kHz control tone superimposed on it. The effective modulation can be up to 50V peak to peak and can cause havoc in the zero voltage detection unless filtered out.

Gate triggering to the Triac is delivered by the paralleled pins 10, 11, 12 & 13 of IC1. Together these can sink a total of 100mA but we limit the current to the gate to around 50mA with a 39Ω resistor. Diode D3 reduces the 0.7V positive voltage which is present on the gate when the Triac is switched on from driving current back into these IC1 gates. Gate triggering pulses are shown in the "Scope 8" oscilloscope waveform. They are 80µs wide and repeat at 10ms intervals.

Extension plates

You can add another extension plate to the system to give



Scope 8: these are the triggering pulses, which are 80µs wide and repeat at 10ms intervals.

RESISTOR COLOUR CODES				
	No.	Value	4-Band Code (1%)	5-Band Code (1%)
☐	2	4.7MΩ	yellow violet green yellow	(NA – must be VR37 type)
☐	2	1MΩ	brown black green brown	brown black black yellow brown
☐	2	680kΩ	blue grey yellow brown	blue grey black orange brown
☐	1	68kΩ	blue grey orange brown	blue grey black red brown
☐	1	47kΩ	yellow violet orange brown	yellow violet black red brown
☐	1	22kΩ	red red orange brown	red red black red brown
☐	2	10kΩ	brown black orange brown	brown black black red brown
☐	1	39Ω	orange white black brown	orange white black gold brown

CAPACITOR CODES		
Value	IEC Code	EIA Code
0.47μF	470n	474
0.1μF	100n	104
0.01μF	10n	103
.0047μF	4n7	472
22pF	22p	22

both touch and infrared control at a second, or even third location.

We'll look at the way this works and how to put it together next month, when we also run through the recommended testing procedure. We'll also look at coding the remote controls.

Construction

The dimmer is constructed on a PC board coded 10101021 and measuring 62 x 72mm. It is mounted on a Clipsal Classic blank plate with a matching blank aluminium touch plate. The completed dimmer will fit inside a standard metal wall box using a 30mm deep mounting block. Alternatively, it can be fitted directly inside a Gyprock wall using standard mounting hardware.

Begin by checking the PC board against the published pattern to ensure there are no shorts between tracks or any breaks in the copper. Repair these as necessary.

Now check that the holes are drilled to the correct sizing for the larger components. The screw terminal mounting holes need to be 1.5mm in diameter, while the PC board mounting holes, the touch plate connection and the cable tie holes to secure L1 should be 3mm or 1/8" in diameter.

Install the resistors (except for the two 4.7MΩ values and the 1kΩ 5W resistor) first, noting that some are mounted on-end. Use the colour code table to guide you in selecting each value. You can also check the values with a digital multimeter.

Now install the socket for IC1, along with the capacitors. The tantalum and electrolytic types must be oriented with the correct polarity, as shown on the overlay. Diodes can be installed next making sure they are also placed with the correct orientation and that the correct type is placed in each position. The Triac can be placed in position as well as the screw terminal strip. Transistor Q1 and crystal X1 can now be soldered in place.

The 1kΩ 5W resistor mounts end-on with spaghetti sleeving over the wire ends. It stands proud of the PC board by about 5mm to clear diode D2.

Inductor L1 is wound using 24 turns of 0.5mm enamelled copper wire around the toroid as shown in Fig.5.

It is not wound in the conventional manner with even spacings of the windings around the core; rather the windings are concentrated over about 25% of the circumference.

This unusual winding method is to keep any stray fields away from the infrared detector which is susceptible to picking up interference and producing erratic results. Do not use a commercially wound inductor as this will have even winding spacings around the core and will prevent the infrared receiver from operating properly.

When you have finished winding the core, pot the windings in some 5-minute epoxy. This will reduce the audible buzz caused by the vibration of the windings when driving the lamp with phase control.

When the epoxy has set, place the inductor in position on the PC board with the windings oriented towards the top and secure in place with a cable tie wrapped around the circumference and through the two holes in the PC board under the core. The wires from the core are soldered into the PC board by first cleaning off the insulation and tinning the wire ends.

The windings will be in close contact with the Triac tab, however, the windings and tab are at essentially the same voltage so there is no particular reason to be concerned about insulating the windings from the tab. You may, however, wish to place a short

The Clipsal CLIC2031VXBA blank wall plate shown here assembled with the PC board. The two nylon PC board mounting screws are on the left and the metal pan-head screw is at the bottom (its head is marginally above the plate surface to ensure contact with the aluminium cover plate). The infrared receiver is at the top, its hole covered by a piece of acrylic sheet glued to the plastic.

length of insulating tape over the windings in the vicinity of the Triac.

Work can now begin on the underside of the PC board.

The 4.7MΩ resistors are mounted first. **You *must* use the specified Philips VR37 types here because they are rated at 2500V.**

Use of standard 1W resistors will jeopardise the electrical safety of the dimmer. You can recognise the VR37 types by their light blue body and yellow tolerance band rather than a gold one.

Cut the excess lead length off on the top of the PC board. Solder the 6mm tapped spacer to the board by first securing it in position with a screw from the top side of the PC board. This will position the spacer correctly before soldering.

If the infrared receiver does not come with an earthed metal shield, you will need to make one for it. It can be made using some tinplate salvaged from a tin can or lid. Cut it out to shape with tin snips and drill out the hole for the receiver lens. Now fold the shield around the body of the receiver. Solder a short length of wire between the centre ground pin to the shield. The unit is now secured to the underside of the PC board as shown.

Note that the shield and the copper area below the sensor are at different potentials, so if the shield makes contact with the board it will short out the 5V supply. Make sure there is no likelihood of shorting here.

A 0.1μF ceramic capacitor is soldered between the shield and PC board.

Place the PC board onto the Clipsal plastic wall plate with the infrared receiver to the side which has the mounting screws stowed away (unless, of course, you have already removed the screws!). This side has mouldings which encroach inside of the wall plate.

Now mark out the hole positions for the two mounting holes adjacent the 4-way screw terminals and for the touch contact screw which secures into the 6mm spacer next to the 4.7MΩ resistor. Drill 3mm holes for each. The two mounting holes should be countersunk from the top side so that the Nylon mounting screws are flush with the top face.

The hole for the metal touch contact screw is also countersunk a little.

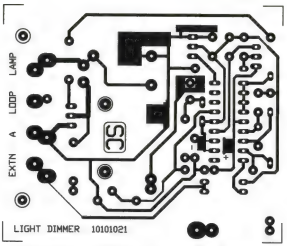


Fig. 4: same-size PC board pattern for the main unit. The extension will be published next month.

Don't make this too deep, as the screw needs to sit proud of the top face by about 0.5mm to make reliable contact with the metal plate when it is attached.

The hole for the infrared sensor must have some form of permanent covering over it to prevent anyone (little people especially!) poking anything inside the hole and possibly making contact with the live parts inside.

We used a small piece of thin red acrylic material firmly glued to the top side of the plate (ie, so it is between the plastic and metal plates). Mark out the position for the infrared receiver lens on the plate and drill out this hole – 4-5mm would be about right. (Too small a hole limits the angle of infrared reception.)

Now clip the metal plate over the plastic wall plate and drill out the hole in the metal plate so the two holes line up. Remove the metal plate and glue the acrylic to the plastic plate with contact adhesive or similar glue.

Incidentally, the sensor needs to be located as close as possible to the inside surface of the plate for best reception of the infrared signal.

The PC board is attached to the plate using **countersunk Nylon screws adjacent to the screw terminals** and the countersunk metal screw which secures into the 6mm tapped standoff. The board stands off from the plate using two 6mm spacers for the Nylon screws. Use M3 nuts to secure the board in place.

Note that you must use Nylon screws and not metal ones for the mounting points adjacent to the screw terminals. This is to ensure electrical safety.

As we mentioned earlier, contact is made between the metal plate and the circuit via a 3mm metal machine screw. We used a pan-head (ie, slightly raised) countersunk screw which, when installed, was just proud of the plastic surface by about half a millimetre or so. When the aluminium dress plate was snapped into place, this screw made reliable contact.

And finally, another warning!

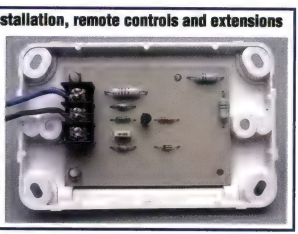
Just in case you missed the warning messages published elsewhere in this project, let's reiterate:

This is a mains-powered project with most parts floating at mains potential. Do NOT attempt to operate it outside of a protective case or box – in fact, leave the testing until next month when we show you how to do it safely.

And if you are going to install it into your home, under current legislation you must be a licensed electrician to even unscrew a wallplate or light switch. Hopefully, that may change in the future! **SC**

Next month: testing, installation, remote controls and extensions

That's about all there is to the basic dimmer. However, we have yet to look at the testing procedure (which is done with low voltage for safety), the types of remote controls suitable and how to set the dimmer codes to suit, installation and also the operation and construction of the remote touch panels/infrared receivers. We'll cover all of this in February SILICON CHIP.



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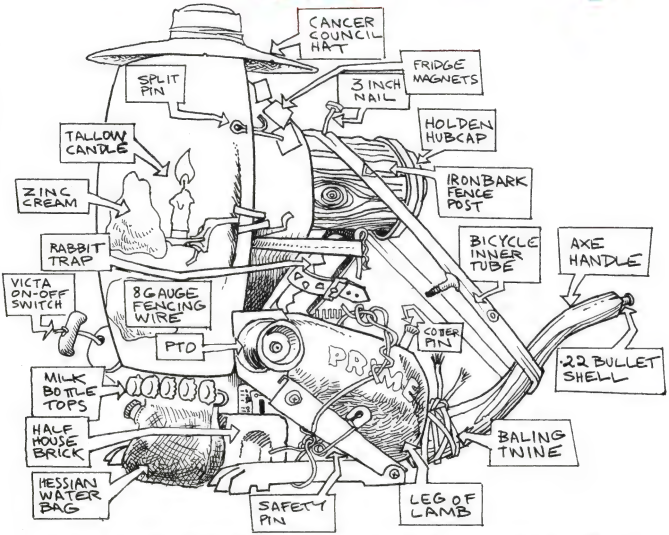

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SERVICEMAN'S LOG

Not enough information – or too much?

It is seldom that I devote a whole column to just two sets of the one brand. One exercise left a lot of unanswered questions and the other was a job that nobody wanted – only nobody told me. And then there was the manual that was too big to be helpful!

Mr Greenspan won his TV set in a competition, so his perception of it probably differs from that of most customers. Because you haven't actually had to shell out your hard-earned shekels, you tend not to appreciate its true value. As a result, when it has the temerity to break down, your loyalty to it is limited. It didn't cost anything, it doesn't owe you anything, so if it is anything serious . . . well, easy come, easy go.

Mr Greenspan's good fortune was an expensive 1992 Philips Matchline 16 x 9 aspect ratio TV set, model 36ML8906/00B, employing an FL 1.2 AA chassis. The tube is a W67EW-5001X42 but to me that is rather meaningless in conveying size because of its aspect ratio. The manual says there are four picture sizes – 21in, 25in, 28in & 33in – but I really don't know which one this is. Its diagonal measurement gives a 76cm (29in) viewable area.

Anyway, Mr Greenspan's set was dead and considering that he had won it and it was now nine years old, he wasn't sure whether he wanted to spend real money on it to have it fixed. I told him I would have a go and spend an hour's labour on it to come up with an estimate. He could then make a decision on that basis.

I removed the back to reveal a large flat split chassis interspersed with a few modules. Access to the copper side of the main board looked particularly awesome and I was so intimidated by the technology that I felt I just couldn't proceed without a service manual. Fortunately I was able to order one.

While waiting for it to arrive, I had a good look at the setup during coffee breaks and while dealing with other sets in the queue. The biggest problem appeared to be that I couldn't reach the copper side of the mother boards while the set was on. This is not the sort of set one can roll onto its side or even upside down.

The chassis could be removed by unplugging it and sliding it back after pressing four locks on either side of both boards. Later, when I acquired the manual, it suggested assembling the two panels with a red clip attached to the signal panel at 90 degrees, though exactly how this was supposed to help access escapes me.

In the meantime, I decided on a course of careful and detailed observation. In fact, no component could be found to have failed visually, and strategic measurements with an ohmmeter confirmed that the set should work. But I did discover a lot of faulty joints all over the power supply and horizontal stages.

Rather than wait for the circuit, I impatiently soldered everything in sight. I also checked for dried out electrolytic capacitors but could find none. Satisfied, I reassembled it all back in the cabinet. I wasn't really very optimistic that I had achieved anything much, so I was really sur-

prised to find that I now had both picture and sound and that even the remote control worked.

However, I soon realised that the picture was far from perfect. It was dark, small and with a tendency to bloom. Nevertheless, I felt that I was probably half way home.

Voltage measurements

Later, when I received the poorly photocopied version of the service manual, the first thing I did was measure the main HT at TP57, the cathode of D6237. I can never understand why important test points do not provide easy access, with a real test point. D6237 is buried in among heatsinks and it is not easy to attach a crocodile clip to it, although I eventually managed. Instead of 141V there was only approximately 105V, depending on the picture tube beam current. Varying VR6370 on the SOPS (Self Oscillating Power Supply) Control Module varied the HT but not by much.

I then spent some time checking all the voltage sources in the power supply and established that all the secondary voltage rails were low. The only exception was that of the separate standby power supply (fSOPS). This gave a higher voltage output than was marked on the circuit. VSTART measured over 20V and is marked 17.5V at TP60 but 5V STBY at TP50 was spot on. I decided that these later observations were irrelevant. And the conclusion was that the control module was the most likely culprit.

The irritating thing was that this control module was shown only as a block diagram. There is no circuit, no part number, nor any reference to it in the chassis service manual. I contacted Philips for more information but no-one had any at all. The only thing I could get was the "SOPS REPAIR KIT 4822 310 31932" for a trade price of $134.09.

Well, it was crunch time for Mr Greenspan. I told him all I knew – which admittedly wasn't much – and the likely costs that might be involved. He sensibly decided to abandon the set and we struck a deal that I could keep the set in lieu of any labour costs I had incurred so far.

I then invested in the repair kit – taking a punt on whatever that was. Two weeks later I received a small box with some components, a list, and a new control module! The ES7028 multilingual list was extremely brief and insisted that I replace all 11 components and the module.

I hate being told what to do, so I carefully examined the circuit and noted which parts they were wanting me to replace.

The first five parts were the main fuse and bridge rectifiers. Then there was another fuse, a chopper transistor, two more diodes and capacitors and a regulator transistor – all of which were working perfectly in this set. Admittedly, a few of these had been modified but only superficially and I really couldn't see this making much difference.

In the end, I just plugged in the new module and switched the set on. And would you believe it? – the picture was now perfect and the main HT was spot on at 141V.

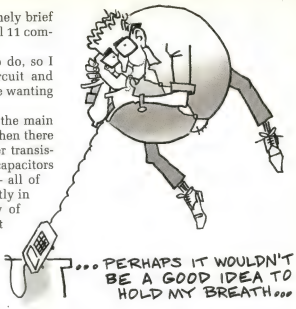
At this point, I imagined that would be the end of the exercise. However, as a matter of course, I put the set on test and left it. Each day, I switched it on for the full working day and switched it off with the remote control before the master power switch was turned off.

The set baulks

After a few days I noticed that the set didn't want to switch on. By jiggling the power on/off switch several times I could sometimes make it come on and then it would stay on for the rest of the day with all functions working perfectly – including the remote control and main power switches.

Gradually, it became worse until finally I had to remove the back and look inside. Just jiggling the module was enough to get it started again and it stayed on. But the problem persisted; every time I switched the set on from cold in the morning, it baulked. Finally, I could only start it by putting in the old module, switching the set on, then switching it off and refitting the new module.

By now, I really wasn't sure whether



it was the new module that was at fault or whether it was another problem altogether. Eventually, after much investigation, I concluded that the new module was faulty and should be returned.

Acting on this turned out to be a drama of its own. First, Philips Spares was in the middle of moving and second, they didn't really believe that the new part was faulty. Eventually, I managed to persuade the Spare Parts Manager to exchange it for another but in view of their move and also lack of stock, I felt that perhaps it wouldn't be a good idea to hold my breath.

He told me to keep breathing and eventually something would be done, so I posted the kit back and prepared to wait.

In the meantime, I regularly glared at the old module whenever I had spare time, trying to guess what the cause of the low HT might be. I particularly looked at the voltage comparator components around transistor 7370 and started to replace some of the surface mounted components such as the 6.2V zener in its emitter.

As the days turned into weeks, I gradually ended up by checking almost every component on this module. The module is actually split into two sections – one section is cold and the other hot and they are connected via an optocoupler very similar to many other Philips TV sets of that generation.

Well, during one coffee break I made an interesting observation and that was to do with the VSTART voltage. (I

Items Covered This Month

- Philips Matchline TV set, Model 36ML8906/00B (FL 1.2AA chassis).
- Philips Matchline TV set, Model 33CE753/42R (3A chassis)

am talking about the old module now; the new one was still with Philips Spare Parts) This voltage comes into the module and goes to a 5.6V zener diode in series with a diode (1N4148) and then to transistor 7371 (all surface mounted). These two diodes were marked 6373 and 6372 respectively.

I then realised that these two diodes were also identically marked on the circuit as being on the motherboard. At first, I thought this was just a circuit mistake but a check confirmed that these two diodes were actually on the motherboard, so this configuration had been duplicated. However, when I looked at the circuit of the new module, which I had drawn earlier, these two components were missing!

So, to summarise, I had a set with a motherboard carrying these two components plus a module - apparently the original – in which these component were duplicated. But on the second (new) module (now with Philips), these components had been left out and had been replaced by links.

What a mix-up; and what did it all mean? In an attempt to clarify the issue, I replaced extra components on the old module with wire links and plugged it back into the set. And when I switched the set on, the picture was perfect and the HT could be adjusted so that it was spot on 141V.

A riddle

I felt elated that I had fixed the problem but recognised that I hadn't solved the riddle. There was a whole swag of questions still to be answered but it appears that Philips made two (at least) versions of this set: one with the two diodes mounted on the motherboard but missing from the module; and one with the diodes in the module but missing from the motherboard. It is hard to imagine a setup more likely to create a mix-up.

Supposedly, this set had worked properly for years with this module in it – or had it? Had Mr Greenspan always had a small picture but just wasn't fazed by it? After all, there is much confusion among owners as to what size and aspect ratio the picture should be: 16 x 9, 4 x 3, or letterbox. Besides, before January this year, it probably was always 4 x 3 and a 16 x 9 set was really superfluous in 1992. Also, Mr Greenspan may have thought it was normal that he was receiving a 4 x 3 picture with the set in 16 x 9 mode.

Or had someone else had a go at Mr Greenspan's set? Getting a set's history out of some owners is like pulling teeth. I'm not supposed to ask "silly questions" like that.

In any case I can't really raise the matter with Mr Greenspan now, so I can only conjecture as to why a set fitted with the wrong module turned up on my bench.

Finally, why did the new module fail intermittently? It will be interesting to see if the replacement module works when it returns from Philips. In the meantime, the set continues to work flawlessly.

Postscript

Subsequently, since writing the above, two events have occurred. First, a new SOPS Control Module arrived and, initially, appeared to be working properly. Unfortunately, it failed after a couple of days and I may be able to write more about this later.

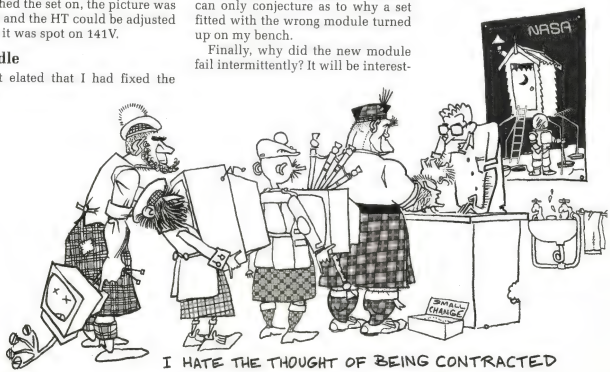
But was this really a new module or had the previous one with the intermittent fault found its way back to me in the confusion caused by the move. Stranger things have happened.

Second, after spending months trying unsuccessfully to acquire a circuit of the SOPS Control Module from Philips, a colleague finally tracked one down. He is an experienced technician who works by himself from home and found it loose with the instruction book for the set. It is not for an FL1.2 chassis, but actually for an FL1.1S (Part No: 4822 727 6395.1/SV00.wk.9148).

So there we are – but where are we?

Another Philips

Mrs Adams' set was a 1989 Belgium-made Matchline 33CE753/42R (3A Chassis) which she had been trying to get fixed. I only found out later



that she had had the set looked at by several technicians who didn't want to know about it. Had I known this I, too, would have been more cautious – much more cautious.

As it was, I was told that it was dead and I was cheaper than the authorised agent. This is always a bad omen – I hate the thought of being contracted just because I am cheap! Still, I take comfort from the fact that the NASA spacecraft components are also constructed (supposedly) by the companies that submit the lowest tenders.

So there I was, at her house, looking at this monster 80kg 84cm TV set, having been given the impression that it had only a faulty fuse - or something equally simple. The set had already been put aside and another placed in its place. My heart was in my boots – I just knew that this was going to be difficult but this is my profession and I need the money.

The back unclipped easily to expose a chassis which must have few rivals for poor access. The whole thing is enclosed with concealed plastic catches and supports. All I could confirm was that power was getting past the power switch and fuse and onto the main chassis. Apart from that, the set was completely dead and I could find no other easily accessible voltage to check.

The set obviously had to go back to the workshop and I also needed a service manual. Initially, I planned to order a new service manual, until I was advised of the cost for a photocopy – $300! I settled for renting it instead.

When the manual arrived, I could see why it was so expensive – it was huge. The main reason is that it covers all the models employing this chassis and all the possible options. So it covered the basic sets, the projection models, plus the medium and high-end versions. My first problem was identifying this particular set's chassis – and that wasn't very easy.

The serial number started with AGO6, which told me it was a later series after AGO3. It had PIP (Picture-in-Picture), SVHS and hifi sound, Teletext and Multisystem – in fact it seemed to have everything.

I never really did discover what VHP, IPP and SYMMETRIC WITHOUT LOUDSPEAKERS meant. More to the point, there was not one complete section or circuit which covered this model in detail. It was a case of a bit of circuit here and a bit there, making the whole thing a schemozzle. Also, while there were fault finding trees, they were just too difficult to comprehend.

In the end, I settled on using basic principles and muddling through. Removing the entire chassis from the cabinet involved raising two clips (B) at the rear and pulling it out. But this gives only limited access to the components on top and virtually nothing underneath.

I found a plug, M17, with a link between pins 5 and 6. This was the 140V HT feed to the horizontal output stage and there was no voltage on this – but neither were there any short circuits, which indicated that the line output transistor 7618 was probably OK. By removing this plug and connecting a 100W globe to pin 6, I could measure 140V.

By now, I had also inspected some of the components on the top of the main board and quite a lot didn't look healthy. I therefore felt that it was a good time to remove the board and give it a detailed examination.

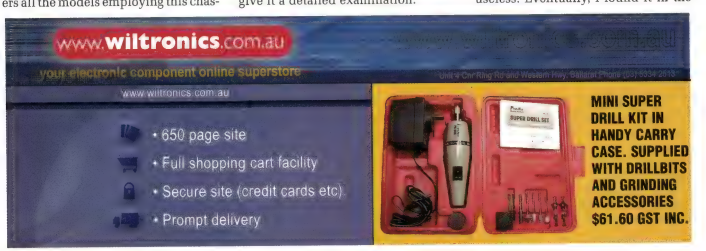
Using an indelible felt tip marker to identify everything, I unplugged the sockets leading to the front controls, the tube and the peripheral modules, before getting it out. Once out, I had to remove two screws holding the AV connectors plus remove a fixing bracket E which holds the modules in. I then released two clips and six screws on either side before the main (mono-carrier) panel would slide out – grudgingly – to the rear.

Now that I could have a good look at what I had, I could see that several electrolytic capacitors needed replacing. I also noticed that R3698 (470Ω) was burnt out and there were a several faulty joints. I replaced capacitors C2638, C2555, C2644 and C2701 on spec, along with C2618 (.001µF 2kV) which had cracks in it.

C2609 (.0082µF, 1.6kV) had been replaced at some stage in the past with the wrong value and capacitor type, so this too was changed. The horizontal output transformer also looked a little the worse for wear but, for the time being, I just resoldered the pins and repaired a few cracks in the PC board near pin 14.

My main worry at this point was to determine what had destroyed R3698, which is from the gate of SCR6698 to chassis – it would need a fair bit of grunt to burn a 470Ω resistor, yet the SCR measured OK. I replaced the resistor and C2698 for good measure before putting it all back together and trying it.

Early on in this story, when I first checked the set in the customer's home, I had neglected to label one of the single plugs coming out of IK13 on the PIP interface panel 1710. Now I couldn't work out where it went and the service manual was completely useless. Eventually, I found it in the



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back of the 100Hz section where it is shown as going to plug IM27 on the main board (which is conveniently hidden under a plastic bracket).

On some circuits, this is also shown as 1M17 and is the 5V standby but quite where it goes to isn't shown on the circuit diagrams. I suspect it goes to the front panel but time prevented me from tracing this further. And I still had no power at all, even with M17 connected.

Next, I shorted the base and the heatsink of the horizontal output transistor, effectively cutting it off. The lamp still glowed when I did this, so it looked as though I was looking for some protection circuit fault.

I removed the chassis again and started an exhaustive DC resistance check. This revealed all sorts of bad news. First, D6702, a 47V zener, was short circuit and F1601, a 315mA button fuse, was open.

It was about now that I was beginning to realise that there was a significant similarity between the 3A chassis and the more popular 2B chassis. With F1601 blown, it was fairly obvious that the horizontal output transformer (5620) was shorted. And guess what – it is identical to the one used in 2BS chassis (EHT6140 substitute). A new one was fitted and the set reassembled but it still refused to start.

This time I followed the circuit from the gate of the SCR via plug M7 pin 2 and onto the Power Amplifier Sound (PAS) module 1003, where I found resistor R3229 burnt out on the collector of transistor 7226 (BC558), which was shorted. The difficulty here was that R3229 is not shown in any circuit at all and in the end I just fitted a link instead.

Now when I switched on, I had sound and picture but there were still problems. The purity was all over the place and I made a mental note to replace PTC 3653, the dual posistor to the degaussing circuit. There was a lot of intermittent chirping noises from the horizontal output stage and when I tapped the horizontal output transformer, the sound would change its pitch.

I tried this several times, then suddenly I had no vertical deflection and the set died completely. The chassis came out again and this time the horizontal output transistor (7618) was shorted and fuse F1601 had blown. I replaced the 2SD1710 with a 2SD1577 as shown on the circuit and I found two long, barely visible cracks between adjacent pins of the horizontal output transformer which were breaking some of the copper tracks.

I repaired all these and replaced D6646 which supplies the 26V to the vertical output stage. I also found cracks in the degaussing sockets (M18 and M19), which I also replaced when replacing the PTC.

Getting there

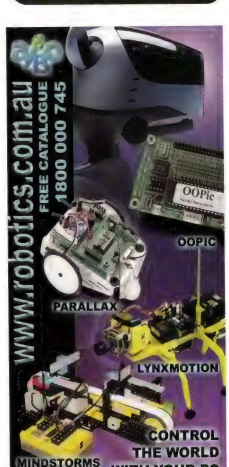
That finally fixed the more urgent problems but unfortunately there were still some minor faults. I still hadn't fixed the intermittent chirping noise and traced that to the deflection yoke before deciding the customer must have always had this and could live with it. In any case, it only happens during the first few minutes from switching on. This she subsequently admitted and she also told me that the set had had a new tube fitted while it was still under warranty.

The next problem was that it took ages for the picture to come on and sometimes it didn't come on at all. This can be indicative of a "flat" (low emission) tube. However, in this case, the collectors of some of the colour output power amplifier transistors had broken their copper PC tracks.

I repaired these and made two modifications to improve the turn-on time, to reduce it to about 10 seconds. One modification involved changing R3492 to 3.3kΩ (was 1.8kΩ) for peak white and the other was to add 150kΩ from IP12 (12V) to 2P12 (Beam Current Information Limiter). This desensitises the auto cutoff control to IC7355 TDA4580.

And that was it. The repair wasn't cheap and even then I didn't charge for all the time taken. However, Mrs Adams accepted the cost and, after a long soak test, I organised for it to be returned. She was extremely suspicious about every move I made while setting it up but it all worked properly and she paid promptly.

I do hope I don't get too many more of these. **SC**



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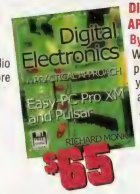

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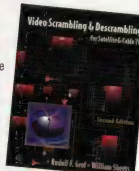

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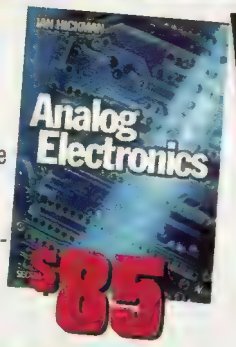

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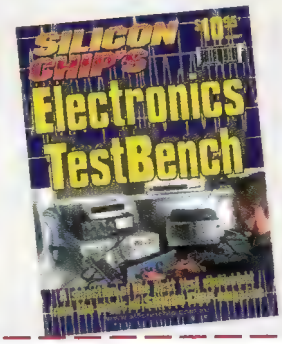

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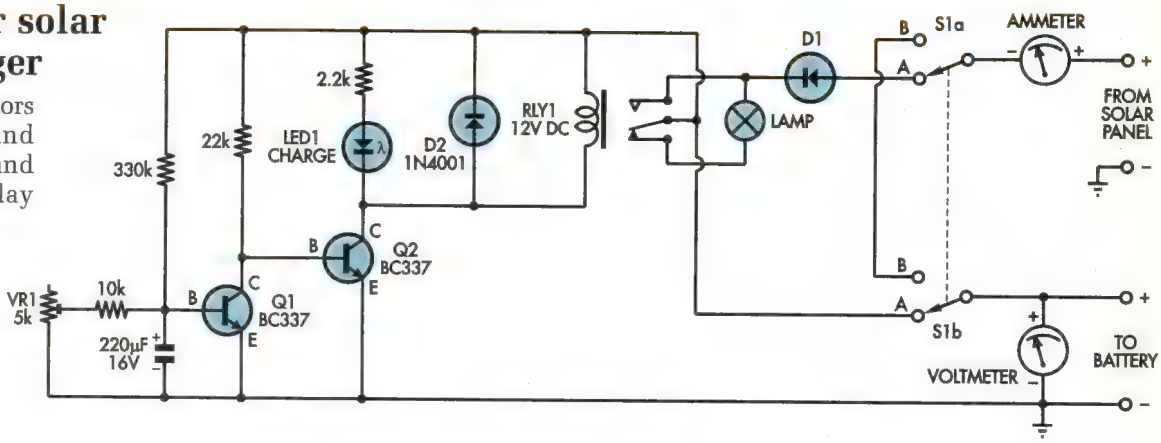
CIRCUIT NOTEBOOK

Interesting circuit ideas which we have checked but not built and tested. Contributions from readers are welcome and will be paid for at standard rates.

Regulator for solar battery charger



Some solar regulators are complicated and tricky to set up, and may also have relay chatter. This version is easy to set up and works positively. The relay is a 12V 400-ohm coil type with 10A contacts (such as Dick Smith P-8017).

Q1 monitors the battery being charged via the 330kΩ and 10kΩ resistors feeding its base. While the battery voltage is below the threshold set by trimpot VR1, Q1 is off, Q2 is on and the relay is energised to pass current from the solar panel and diode D1. Q2 also lights LED1.

When the battery voltage rises above the threshold set by VR1, Q1 turns on, removing base current from Q2 which then turns off the relay. The 220µF capacitor at the base of Q1 prevents relay chatter.

Once the relay is open, a trickle charge can be maintained via a suitable incandescent lamp which bypasses the relay contacts.

The meters and changeover switch can be regarded as optional. To set the cutoff voltage (eg, 13.8V), apply 14-15V to the battery terminals and adjust trimpot VR1 until LED1 goes out at the desired voltage.

E. Sherman,
Kawhia, New Zealand. ($30)

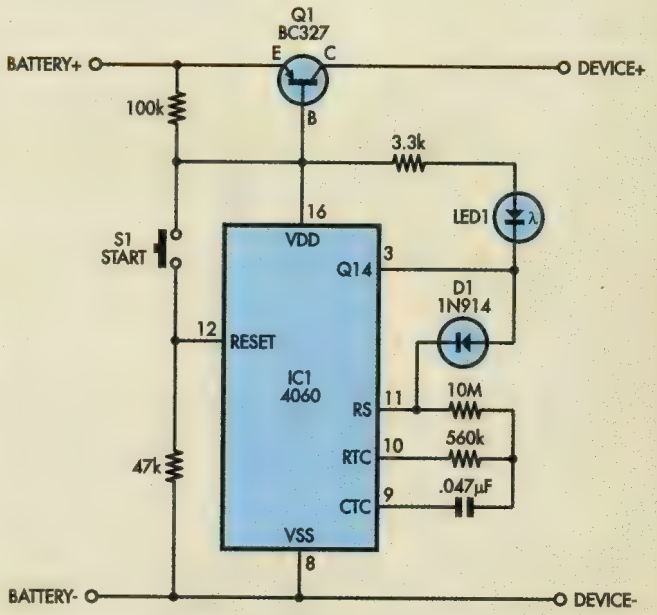
Simple time switch for battery-operated projects

The use of this simple timer will prevent batteries from going flat because you forgot to turn off the power. It uses a momentary pushbutton switch to apply power to the controlled device and then, after a delay of about eight minutes, power is automatically cut. Timing can be restarted at any time during the 8-minute interval.

The 4060 14-Stage Ripple Carry Binary Counter governs the ON timing duration with the R/C combination at its clock inputs, pins 9, 10 and 11, providing the rate of clock pulses. Q1 switches power in the positive line to the device to be controlled when IC1's Q14 output goes low. A high-brightness LED is included as an ON indicator but can be deleted if not required.

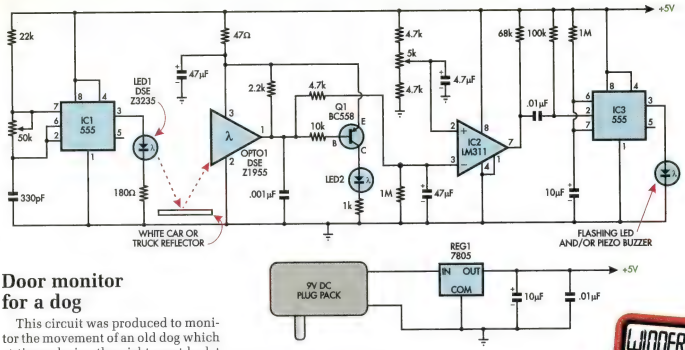
IC1 is permanently connected to the battery supply but draws just a few microamps of current when dormant. This current flows through a 100kΩ resistor and insufficient voltage is induced across the base-emitter junction of Q1 to turn it on. The Reset pin of the 4060 is held low by a 47kΩ resistor and as a result, output Q14 (pin 3) is set high. This also holds pin 11 high via D1, preventing the clock from pulsing.

When the pushbutton is pressed, two events take place. The Reset pin of IC1 now becomes momentarily high, resetting all Q outputs Low. With Q14 low, Q1 then turns on to power the external circuit. After about eight minutes, the count sets Q14 high again and Q1 turns off.



The timing duration can be varied by using a different capacitor value on pin 9 of IC1. Supply voltages from 5-15V are acceptable but the 3.3kΩ resistor should be tailored to provide about 5mA base current to Q1.

Colin Christensen, Redcliffe, Qld. ($40)



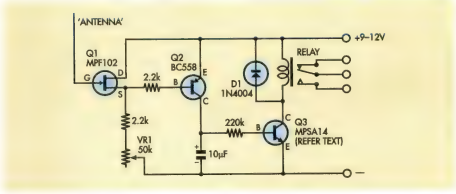
Door monitor for a dog

This circuit was produced to monitor the movement of an old dog which at times during the night must be let outside. A door monitor set low off the ground would have sufficed but it needed to discriminate against cats as well.

The first 555 pulses the infrared LED at 38kHz and the light output reflects off a car or truck reflector to be picked up by the infrared detector IC. When it picks up infrared, its output goes low to turn on the visible LED via the BC558 transistor. This LED serves both as a power on indicator and is used to set up the reflector.

The height of the transmitter and receiver (optically isolated but in the same box) was set a little below the shoulder height of the dog. To prevent false alarms from cats' tails occurring, an RC time delay was included, comprising the 1MΩ resistor and 47µF capacitor at pin 3 of the LM311 comparator. This comparator goes low to provide a clean trigger signal to the second 555 timer, which operates as a monostable to drive a flashing LED and/or a piezo buzzer for 10 seconds.

Paul Walsh, Montmorency, Victoria.



Electric field proximity switch

This little circuit does not pretend to compete with the Body Detector sensor featured in the October 2001 issue of SILICON CHIP but its sensitivity for so simple a circuit is very high. The circuit will respond to both RF and electrostatic fields.

The proximity switch behaves rather like the automatic door-opener at the entrance to many stores. A person approaching will activate the device and open the doors but if the person then stops and remains still, the doors will close.

With no moving objects within its range, the field strength varies slowly and has no effect on the device. But a large body such as a person entering its zone of operation results in large changes in the field strength.

continued on page 44

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As you can see, we pay good money for each of the "Circuit Notebook" contributions published. But now there's an even better reason to send in your circuit idea: each month, the best contribution published will win one of these superb Wavetek Meterman 85XT true RMS multimeters - valued at around $380! So don't keep that brilliant circuit secret any more: send it to SILICON CHIP and you could be a winner!

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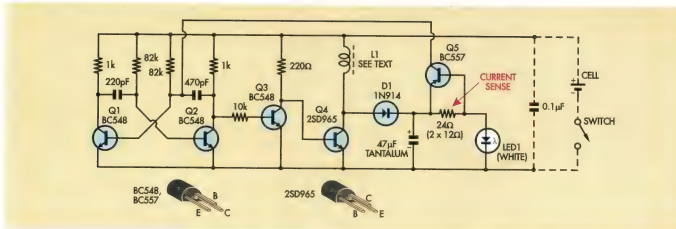

White LED torch circuit uses flash parts

This circuit is essentially the same as in the December 2000 article but has a current regulator to drive the white LED. In effect, the current regulator senses the LED current and adjusts the pulse width from the two-transistor multivibrator to vary for the charging of the inductor. The discharge time for the inductor remains constant.

Hence, with a fresh battery, the multivibrator runs fast and gradually slows as the battery runs down. This circuit will allow operation down to a battery voltage of 0.8V with a useful light output. With a battery voltage of 1.5V the LED current is approximately 20.5mA. A battery of 1.2V, gives a LED current of approximately 19mA. The efficiency of the circuit varies between 52% and 58%.

The main switching transistor is a 2SD965. It is available for free, along with the small inductor (a transformer with a 8.5mm x 8.5mm core) that is used in this circuit. These parts along with many other useful bits and pieces come from the electronic flash units that are fitted into cheap disposable cameras.

To get them, go to a 1-hour film processing shop and kindly ask for any disposed cameras from their rubbish. Most places are helpful. Sometimes you even get the alkaline battery which is still useful. Get several different cameras because the transistor and tiny inductor come out of different makes of camera.

WARNING: when taking these cameras apart, be aware that the flash reservoir capacitor may still be charged up to about 300V DC. This can be LETHAL. Be sure to discharge this capacitor before working on the unit.

The transformer comes apart very easily. Remove it from the flash unit. Unwrap the tape around the core and heat the core on the barrel of your soldering iron for a short time. The wax holding the core together will soften. Using rags to protect your fingers, gently open the core. While the core is still hot wipe off as much wax as you can.

Be gentle as the ferrite and former are delicate. Remove the windings from the former. Wind on 24 turns of 0.3mm or 0.4 mm enamelled copper wire. Wire size is not too critical. Reassemble the core onto the former and wrap with insulation tape.

When testing, use a 150Ω resistor as the load. The voltage across the load will be close to 3V. If operating the torch from a 3V battery, increase the current sense resistor to 27Ω.

Duncan Graham,
Hamilton, NZ. ($40)

Electric field proximity switch – ctd from page 43

Referring to the circuit diagram, the sensor is nothing more than a stiff piece of wire, insulated or bare, standing vertically like an antenna, approximately 15cm long. This is connected to the gate of FET Q1 which is connected as a source follower and operates as a high-impedance buffer with a low output impedance.

The source of Q1 drives the base of PNP transistor Q2 which charges the 10µF capacitor at its collector in response to voltage changes picked up by the antenna. Q2 also drives Darlington transistor Q3 via a 220kΩ resistor and this, in turn, drives the relay. The 220kΩ resistor and 10µF capacitor provide a delay so the relay stays on for up to 30 seconds.

In use, trimpot VR1 should be adjusted for maximum sensitivity by setting it at the point where the output just turns off. This is preferably done before installing the 10µF capacitor.

The circuit may be susceptible to certain nearby electrical appliances but not normally overhead lighting. In some situations, the unit can sense the presence of a person from two metres away but its performance depends on the clothes worn, the level of friction generated, the dryness of the air, etc. It reacts violently to polythene film.

In its standby state, it draws less than 1mA, depending on the setting of VR1.

J. A. Lee,
Old Reynella, SA. ($30)

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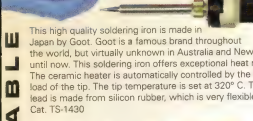

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•Output power: 300W continuous . •Surge power: 500W •Standby current: <0.6A •Input voltage: 10 - 15VDC •Output wave form: Sine Wave •Low batt shut O/ff: 10V •Overload: Shutdown •Battery Reverse: Internal Fuse •Input Connectors: 6 gauge
•107(W) x 60(H) x 280(L)mm: •1.65Kg

Cat. MI-5082

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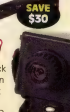

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This station is designed in Germany and is microprocessor controlled and incorporates an LCD display giving precise accuracy over temperature, also with 3 presettable temperatures you can quickly change, it also has an energy saving feature lowering temperature in between long pauses of use. Iron is rated at 24v 48 watts and temp range is 150degC to 450degC. Three replacement tips and sponge are also available. Cat. TS-1400

$249

BUY THIS MONTH & RECEIVE FREE AN EXTRA TIP OF YOUR CHOICE AND A 200G ROLL OF SOLDER WORTH OVER $22

12 Volt Compact Flouro Lights Slashed

These are a great innovation that gives you the energy efficiency of PL fluoro lights for use on 12-volt systems making them perfect for the car or caravan and for solar homes. (E-14 base required).

13 WATT 3D TUBE

Equivalent to 60 watt globe, 670mA, 140mm long.

Cat. SL-2850 **WAS $26.95**

$18.95

SAVE $8

20 WATT 3D TUBE

Equivalent to 100 watt light globe, 800mA, 150mm long.

Cat. SL-2852 **WAS $32.95**

$23.95

SAVE $9

E14 BASE (MES)

This base suits the above 12 volt flouro lamps. Cat. PS-4072

$3.95

Laboratory Micro Burner

NEW

This attractive, compact and versatile burner will find many uses in laboratory and domestic applications. The burner uses butane gas and will run for up to 120 minutes on one refill. The burner has a host of features including: •piezo ignition •adjustable flame •carry handle •non slip base •flame temperature is 1300°C. •measures 85(H) x 125mm across the handle.

Cat. TS-1664

$49.95

Bench Stand For Micro Lab Burner

Designed for use with our TS-1664 micro burner and ideal for supporting small beakers and test tubes etc. in the lab or just heating a small pot of tea/coffee etc. •Measures 110mm across the base and 110mm high. •Assembly instructions included. Cat. TS-1665

NEW

$12.95

Piezo Pocket Gas Torch

NEW

Ideal for brazing, silver soldering, jewellery work, heat shrinking, plumbing and general hobby work. Includes bonus stand. Features: •Piezo ignition. •Adjustable flame. •Portable. •Easy refill with standard butane gas. •High temperature 1300°C flame. •Use our NA-1020 butane gas refill. •Size 155mm high x 35mm dia tank. Cat. TS-1662

$19.95

Ultrasonic Cleaner

SAVE $20

This great little unit creates tiny bubbles to reach deep into cracks & holes to remove dirt and grime. Cleans jewellery, glasses, switches etc etc. built in 15 min timer.

Cat. YH-5400 WAS $169

$149

GOOT Desolder Braid

High quality Goot brand "Gootwick", made in Japan. Contains wash-free RMA flux and conforms to MIL-F-14256F. •Supplied in plastic reels. •1.5 metres long.

Cat. NS-3026 1.5mm wide

Cat. NS-3027 2.0mm wide

Cat. NS-3028 3.0mm wide

$4.95ea

SAVE $$$ ON OUR DISCONTINUED PRODUCT SELLOUT

OVERNIGHT DELIVERY AVAILABLE

30 Range DMM

$54.95

Features:
- Probe lockout shutters
- Backlit display
- Temperature
- Data hold button
- Continuity buzzer
- Extra large display

Was $69.95
Cat. QM-1301
LIMITED STOCKS

SAVE $15

Digital + Analogue Meter

$72.95

Features:
- Dual display
- Frequency
- Capacitance
- Data hold
- Temperature
- Current

Was $87.95 Cat. QM-1050
LIMITED STOCKS

SAVE $15

Frequency DMM

This DMM features:
- Probe lockout
- Backlit display
- Temperature
- Frequency
- Continuity buzzer
- Extra large display

$65

Was $85
Cat. QM-1321
LIMITED STOCKS

SAVE $20

3.75 Digit, True RMS, PC Link Bench DMM

This DMM features:
- RS-232 Interface
- Capacitance
- Analogue bar graph
- Auto ranging
- Frequency
- Max/min
- Data hold

$234

Was $279 Cat. QM-1240
LIMITED STOCKS

SAVE $45

Digital Lux Meter

Features include:
- Digital display
- Hold button
- Carry case
- Range D lux -50,000 lux
- 3 Ranges

$69

Was $99 Cat. QM-1585
LIMITED STOCKS

SAVE $30

Pen Style Thermometer / Hygrometer

LIMITED STOCKS

This features:
- Dual display
- Humidity range 0% to 100% (+/-5%)
- Temperature range -20°C to -50°C (+/-1°C)
- Max/min
- Hold button

$69

Was $119 Cat. QM-1595

SAVE $50

Programmable Digital Thermostat

This unit can be programmed with up to 4 temperature changes on weekdays and 2 changes each for Saturday and Sunday. For use where any common thermostat is used.
Cat. QT-7196
Was $47.95

SAVE $12.95

$35

Ultrasonic Tape Measure

Get a rough measurement in seconds.
Up to 12.5 metres range.
Cat. QM-1620
Was $69.95

SAVE $20

$49.95

Colour Pro CCTV Camera SONY SENSOR

This camera has an amazing 400 TV line resolution down to 1 Lux. For a super clear image the camera uses either a standard lens, of which 3 veiwing angles are available, or a wide angle auto iris lens. Lenses sold seperately.
Cat. QC-3304 **Was $359**

$259

SAVE $100

CCD B&W Board Camera

This tiny camera is so small that it can be mounted anywhere and gives a clear picture even in low light. 380 Lines, 0.5 Lux use our MP-3011 300mA powerpack.
Was $115 Cat. QC-3462

SAVE $36

$79

B/W Pan + Tilt Speed Dome Camera with Audio

This camera can pan 355 degrees and tilt 80 degrees, at a speed of 15 degrees per second, and is very quiet when doing so, enabling you to look around a room or area discretely. 380 TV Lines 0.1 Lux, 92° viewing angle. Controller box to suit QC-3200 for $249.
Cat. QC-3210 **Was $549**

$449

SAVE $100

Deluxe Coax Crimping Tool Kit

SAVE $44

This kit includes 5 different crimoing dies, a cable stripper and assorted crimp plugs in a carry case.
Cat. TH-1879
Was $239

$199

12V Active Colour Antenna UHF/VHF/FM

IDEAL FOR CARAVANS, CARS, CAMPING AND HOUSES WITHOUT 240VAC MAINS!
This antenna contains an amplifier to boost signal up.
Cat. LT-3170
Was $59.95

$49.95

SAVE $10

Advanced Programmable Thermostat

Fully featured thermostast that can give you up to 9 customised profiles, eg each weekday it can control warming of the house in the morning and evening and on the weekend warm all day. Temperature control range: 7°C to 30°C
- Switching capacity: 250VAC @ 5A.

Cat. QT-7198
Was $79.95

$59.95

SAVE $20

Small Speakers Stand

For use with floor standing speakers these stands heighten sound stage and reduce muddy sound using built in spikes. All steel construction.
Cat. CW-2842
WAS $82.95

$69.95

SAVE $13

LCD Project Counter Bargain

Keep on schedule with this countdown timer up to 2999 days.
Cat. XC-0125 **Was $24.95**

$9.95

SAVE $15

Superglow Clock

This travelling clock has a beep alarm and large bright backlit display.
Cat. XC-0228
Was $23.95

$19.95

SAVE $4

Mini Grinder

This handy grinder can be used for many small jobs. Requires power via 12 volt plugpack, use our MP-3015
Cat. TD-2487 **Was $16.75**

$11.75

SAVE $5

RF Modulator Bargain

These suit the Dreamcast - ideal for the hobbyist, simply cut off the plug and rewire.
Cat. LM-3875
WAS $28
BARGAIN $8
SAVE $20

What A Flop

Preprogrammed Remote Control with In-built Clock

SAVE $5

This compact remote can control up to 3 devices. By using included codes, list program to operate many common brand TVs and videos. Cat. AR-1700
Was $34.95

$29.95

CTS formally MOTOROLA Piezo Super Car Tweeters

A quick and easy way to increase treble in your car system with or without an amp.
Cat. CS-2215 **Was $47.95Pr**

$35Pr

SAVE $12.95

RESPONSE 7" x 10" Car Speakers

Big bass sound from our premium quality car speakers.
These 7" x 10"'s Pump!
Were $115ea
Cat. CS-2291

SAVE $26

$89ea

SPECIAL FOR ORDERS 1800 022 888

SAVE $$$ ON OUR DISCONTINUED PRODUCT SELLOUT

Limited quantities on all these - so get in quickly and avoid disappointment!

2 RCA + 1 PAL SKT WALL PLATE
Cat. PS-0298 **NOW $4.00** WAS $7.80 SAVE $3.80

IN/OUT THERMOMETER WITH DATE + TIME MEMORY
This thermometer can tell you min or max temperatures at exact times and dates.
Range -39°C to 49°C +1°C. Cat. QM-7210
NOW $29.50 WAS $39.50 SAVE $10

1 X D25 SOCKET WALLPLATE
Power Point Size. Cat. PS-0835 **NOW $2** WAS $5.70 SAVE $3.70

3-5MM NUT DRIVER SET
This low cost set of 5 drivers ranging from 3-5mm fit comes in a handy case. Cat. TD-2006
NOW $6 WAS $8.95 SAVE $2.95

12 PC ELECTRICAL TOOL KIT
A must if you want all the essentials all in one place!
Cat. TD-2056 **NOW $44.95** WAS $54.95 SAVE $10

MINI KEYRING SAFETY LIGHT
Great for being seen while walking or jogging.
Cat. ST-3045 **NOW $3.95** WAS $6.80 SAVE $2.85

1 BNC SOCKET WALLPLATE
Standard Power Point Size. Cat. PS-0653
NOW $4 WAS $6.70 SAVE $2.70

IN/OUT MAX/MIN ALARM THERMO
This unit can be set to beep its alarm when a pre-determined Hi or Low temperature is reached.
Range -50°C to 70°C. Cat. QM-7212
NOW $29.95 WAS $42.95 SAVE $12.95

DURATECH MICRO TORCH
Cat. TS-1675 **NOW $39.95** WAS $52.95 SAVE $13

EMAIL YOUR ORDERS TO mailorders@jaycar.com.au

LIGHTWEIGHT DIGITAL HEADPHONES
These fully adjustable headphones have soft leather padded ear cups and a 1.4m lead.
Cat. AA-2006 Was $20.95
NOW $14.95 SAVE $6

NOISE CANCELLING HEADPHONES
Designed to reduce backround noise such as a jet engine hum of an aeroplane, or to just relax better while listening to music on a plane or with a Walkman.
Cat. AA-2024 WAS $79.95 **NOW $59.95** SAVE $20

SENNHEISER HD56 HEADPHONES
These quality European brand headphones are a great upgrade for your portable audio.
Cat. AA-2040 WAS $49.95
NOW $39.95 SAVE $10

MORE DISCONTINUED PRODUCTS - COMPUTER SPECIALS Limited quantities on all these

IEC 320 IN LINE SURGE PROTECTOR
This small unit connects inline with your power lead and is invaluable to protect your computer and monitor. Cat. MS-4017
NOW $24.95 WAS $37.95 SAVE $13

FIG 8 IN LINE SURGE PROTECTOR
This will plug in line with your Ghetto Blaster, laptop or even Playstation. To be surge protected. Cat. MS-4014
NOW $19.95 WAS $27.95 SAVE $8

CLOVERLEAF STYLE IN LINE SURGE PROTECTOR
Even with this rare type of plug your appliances can be safe from surges. Cat. MS-4016
NOW $24.95 WAS $37.95 SAVE $13

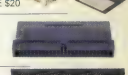
PENTIUM 11 COOLER
Cat. XC-5050 **NOW $14.95**
WAS $19.95 SAVE $5

CELERON CPU COOLER
Cat. XC-5052
NOW $13.95 WAS $18.95 SAVE $5

HARD DRIVE COOLING FAN
Keep your hard drive running cool and reliable. Cat. XC-5046
NOW $14.95 WAS $29.95 SAVE $15

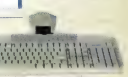
MONITOR COOLING FAN
Reduces monitor temperature by up to 30°C for more reliability.
Cat. XC-5049
NOW $14.95 WAS $32.95 SAVE $17.95

UNIVERSAL HOT SWAP BAY
Swap your hard drive, zip, drive tape, drives etc. without the need to power down and rebooting your system. Cat. XC-4673 **NOW $69.95** WAS $89.95 SAVE $20



SCSI TERMINATOR
IDE drive 50 pin IDC double sided internal SCSI terminators. Passive throughput. Cat. PA-0890
NOW $5.95 WAS $9.95 SAVE $4

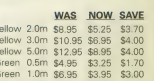
NOTEBOOK SECURITY LOCK
A wire rope joins to your D9 serial port and to your desk to stop your laptop - going missing. Cat. XL-5090
NOW $29.95 WAS $39.95 SAVE $10



3.5" FLOPPY DRIVE CLEANER
Cat. XC-4790
NOW $3.00 WAS $4.95 SAVE $1.95

WIRELESS IR KEYBOARD
Now you can be free of the confines of cable while you work. Also has built in multimedia buttons. Cat. XC-5154
NOW $99.95 WAS $119.95 SAVE $20

MULTIMEDIA KEYBOARD
This keyboard gives extra functions on the multimedia keys allowing you to work faster and easier. Cat. XC-5152
NOW $34.95 WAS $47.95 SAVE $13



BS-II IC BASIC STAMP
Cat. XS-5530
NOW $99 WAS $119 SAVE $20

LOWER PRICES FOR CAT5e FOR 2002

CAT No			WAS	NOW	SAVE
YN-8200	Blue	0.5m	$4.95	$3.25	$1.70
YN-8201	Blue	1.0m	$6.95	$3.95	$3.00
YN-8202	Blue	2.0m	$8.95	$5.25	$3.70
YN-8203	Blue	3.0m	$10.95	$6.95	$4.00
YN-8204	Blue	5.0m	$12.95	$8.95	$4.00
YN-8205	Blue	10m	$18.95	$12.95	$6.00
YN-8206	Blue	15m	$22.95	$16.95	$6.00
YN-8207	Blue	20m	$29.95	$21.95	$8.00
YN-8208	Blue	30m	$39.95	$32.95	$7.00
YN-8210	Red	0.5m	$4.95	$3.25	$1.70
YN-8211	Red	1.0m	$6.95	$3.95	$3.00
YN-8212	Red	2.0m	$8.95	$5.25	$3.70
YN-8213	Red	3.0m	$10.95	$6.95	$4.00
YN-8214	Red	5.0m	$12.95	$8.95	$4.00
YN-8220	Yellow	0.5m	$4.95	$3.25	$1.70
YN-8221	Yellow	1.0m	$6.95	$3.95	$3.00

CAT No			WAS	NOW	SAVE
YN-8222	Yellow	2.0m	$8.95	$5.25	$3.70
YN-8223	Yellow	3.0m	$10.95	$6.95	$4.00
YN-8224	Yellow	5.0m	$12.95	$8.95	$4.00
YN-8230	Green	0.5m	$4.95	$3.25	$1.70
YN-8231	Green	1.0m	$6.95	$3.95	$3.00
YN-8232	Green	2.0m	$8.95	$5.25	$3.70
YN-8233	Green	3.0m	$10.95	$6.95	$4.00
YN-8234	Green	5.0m	$12.95	$8.95	$4.00
YN-8240	Grey	0.5m	$4.95	$3.25	$1.70
YN-8241	Grey	1.0m	$6.95	$3.95	$3.00
YN-8242	Grey	2.0m	$8.95	$5.25	$3.70
YN-8243	Grey	3.0m	$10.95	$6.95	$4.00
YN-8244	Grey	5.0m	$12.95	$8.95	$4.00
YN-8272	Xover	2.0m	$8.95	$5.25	$3.70
YN-8274	Xover	5.0m	$12.95	$8.95	$4.00
YN-8275	Xover	10m	$18.95	$12.95	$6.00

OVERNIGHT DELIVERY AVAILABLE

FREECALL FOR ORDERS 1800 022 888

OVERNIGHT DELIVERY AVAILABLE

Sound Studio On A Budget

NEW

Recording or rehearsing in a professional studio can be expensive business. This book is written for musicians with high hopes (but a limited budget), and shows you how to build a professional sound studio less expensively than you probably thought possible. It also gives you details on how to set up home theatre. Softcover, 298 pages. Cat. BA-1430

$74.95

91 Element UHF Antennas

If you are having trouble picking up UHF stations such as SBS or CH31 this antenna could help, strong gain of up to 19dB to assist in deep fringe areas, clamp balun for coax included. Cat. LT-3182 **WAS $87.95**

SAVE $18

$69.95

UHF/VHF Hi Gain TV Antenna

SAVE $30

This antenna is suitable for all common channels and is digital ready and is suitable for inner fringe-to-fringe areas. The build of this antenna is strong, using architectural strength extruded aluminium designed to last. Includes new style balun (F-type). Cat. LT-3155 **WAS $155**

$125

Masthead Amplifier

SAVE $10

If you have snow affected picture or none at all you may need one of these boosters. Designed and made in Australia these are the best you can get with VHF gain of up to 20dB and UHF gain up to 36dB both of which are are adjustable so you can fine tune your boost to get the best picture, and installation only takes minutes. Supplied with short circuit proof plug pack. Cat. LT-3290 **WAS $89.50**

$79.50

Indoor TV Antenna / Amplifier

This indoor TV antenna includes an amplifier. The amplifier has 24dB gain on VHF and 20dB gain on UHF as well as a gain control. It operates directly from the 240V mains power supply, so no extra plugpack is required. There is an auxiliary input socket also, for connecting a TV game, or any other device. Cat. LT-3195 **WAS $64.95**

SAVE $10

$54.95

CRAZY BOOK SELLOUT

Limited stocks

IC DATA AND SUBSTITUTION MANUAL
Was $39.95 **Jan $29.95** Save $10 Cat. BM-4552

INTRO TO ROBOTICS W LEGO MINDSTORMS
Was $49.95 **Jan $39.95** Save $10 Cat. BB-7054

PRACTICAL ELECTRONIC TIMING
Was $19.95 **Jan $12.95** Save $7 Cat. BB-7012

ELECTRONIC PROJECTS FOR THE GARDEN
Was $20.95 **Jan $13.95** Save $7 Cat. BB-7035

MAGIC ELECTRONIC PROJECTS
Was $19.95 **Jan $12.95** Save $7 Cat. BB-7033

ELECTRONIC HOBBIEST DATA BOOK
Was $23.50 **Jan $14.50** Save $9 Cat. BB-7305

CIRCUIT SOURCE BOOK
Was $19.95 **Jan $12.95** Save $7 Cat. BB-7006

GETTING STARTED IN PRACTICAL ELECTRONICS
Was $20.95 **Jan $13.95** Save $7 Cat. BB-7041

PRACTICAL OSCILLATOR CCTS
Was $20.95 **Jan $13.95** Save $7 Cat. BB-7052

SIMPLE L.E.D. PROJECTS VOL 2
Was $12.95 **Jan $8.95** Save $4.00 Cat. BB-7016

SIMPLE TERMINAL BLOCK PROJECTS
Was $20.95 **Jan $13.95** Save $7 Cat. BB-7057

30 SIMPLE I.C. TERMINAL BLOCK PROJECTS
Was $19.95 **Jan $12.95** Save $7 Cat. BB-7010

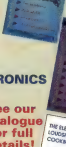
POWER AMP PROJECTS
Was $55.95 **Jan $34.95** Save $21 Cat. BA-1418

PRE-AMP AND FILTER CIRCUITS
Was $16.95 **Jan $9.95** Save $7 Cat. BB-7045

THE ELECTROSTATIC DESIGN COOKBOOK
Was $86.95 **Jan $51.95** Save $35. Cat. BA-1404

THE ELECTROSTATIC DESIGN & CONSTRUCTION
Was $49.50 **Jan $29.50** Save $20. Cat. BA-1406

PROJECTS FOR ELECTRIC GUITAR
Was $20.95 **Jan $13.95** Save $7 Cat. BB-7047



See our catalogue for full details!

Pre-Built PIC Programmer

NEW

This pic programmer is pre built and will connect to your PC'S parallel port to download data and to program your chip. Software to program the 16F84 can be downloaded from the Internet. This unit can program dozens of other pics including the 12C508. See cat for list. Cat. XC-4400

$59.95

Iomega ZIP Disk 250Mb

NEW

Fit more on you zip disk with the new version allowing more than twice the memory. Not compatible with 100MB drives. Cat. XC-4762

$33.95

USB Flash & Smart Card Reader

SAVE $50

Save time downloading pictures from your digital camera with this plug & play USB card reader. Suits both "compact flash" and "smart media" cards used in digital cameras, PDAs portable mp3 players etc. Cat. XC-4770 **WAS $149.95** NEW LOW PRICE

$99.95

RF Wireless Scroll Mouse

SAVE $20

R.F. technology creates a cable free ease of use to your mouse. Includes iWheelWorks software. Ppowered by 2 AAA batteries and the R.F. receiver simply plugs into the PS/2 port on your computer. Cat. XM-5120

CAT PRICE $69.95

$49.95

DIGITAL CAMERA MEMORY +CD-R MEDIA

NEW LOW PRICES FOR 2002

Compactflash™

Rewritable, non-volatile storage. Fully compatible with CFA & PC Card ATA standard. •36.4x42.8x3.3mm

	CAT	Now	SAVE
16mB	XC-4771	$99.95	$42.00	$57.95
32mB	XC-4772	$165	$61.95	$103.05
64mB	XC-4773	$295	$99.95	$195.05
128mB	XC-4774	$409	$189.95	$219.05

Smartmedia™

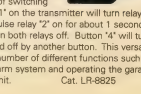
Rewritable, non-volatile storage medium for high capacity portable devices such as Digital Cameras, PDAs, MP3 players etc. Fully compatible with PCMCIA release 2.1. •45 x 37x 0.76mm

	CAT	Now	SAVE
16mB	XC-4775	$99.95	$36.95	$63.00
32mB	XC-4776	$165	$55.95	$108.05
64mB	XC-4777	$295	$109.95	$185.05

See cat page 156 for our range of memory cards, adaptors and readers

Dual Relay Remote Control Switch

NEW



This unit has two relays in the receiver and 4 buttons on the transmitter to provide a combination of switching options. Pressing button"1" on the transmitter will turn relay "1" on. Pressing button "2" will pulse relay "2" on for about 1 second and pressing button "3" will turn both relays off. Button "4" will turn relay "2" on until it is turned off by another button. This versatile switch can be used for a number of different functions such as arming or disarming an alarm system and operating the garage door, all in one compact unit. Cat. LR-8825

$129.95

Telephone + Mains Surge Protector

POWERTECH

This item is essential for anyone owning a computer. Surges during storms and power failures cause a lot of damage to your PC and this item can save you money.
Cat. MS-4026
WAS $22.95

SAVE $5

$17.95

Telephone And Dual Mains Phone Protection

POWERTECH

SAVE $7

Similar to our MS-4026 but with 2 mains outlets.
Cat. MS-4028
WAS $29.95

$22.95

Cool Tubes Blacklight Sensitive Tubing

NEW

With Cool Tubes you can make signs, masks, theatrical props and artwork – uses limited only by your imagination! Cut the tube to length, insert the wire and bend to shape and, when placed near a blacklight source, the tube will glow like neon! Kit includes 4 x 1.5 metre rolls of coloured tubing, shaping wire and dozens of clips & joiners. Colours included are orange, blue, green & pink. Cat. SL-3180

$12.95

25 Watt Soldering Iron

Cat. TS-1410
WAS $15

$10 SAVE $5

80 Watt Soldering Iron

Cat. TS-1420
WAS $22.50

$17.50 SAVE $5

Spark Plug LED Keyring Torch

NEW

Super Bright

One for the auto enthusiasts! This tiny torch looks just like a real spark plug but is really a sophisticated LED torch. Powered by three mini button cells (included).
Cat. ST-3068 White
or ST-3069 Blue

$14.95ea

Multi-Colour LED Glowlight Pen

NEW

We're not sure if the inventor of the ballpoint pen had this in mind, but we suspect they would have been suitably amused with this funky pen! Once activated, the pen's clear barrel floods with changing, flashing colours, changing flash rate and fading from one colour to the next. Amusing and unique! Cat. ST-3092

$24.95

Ultraviolet Super Bright LED Keyring Torch

Our latest addition. This model produces a bright UV light for fun at niteclubs or as a UV source to quick check for UV water- marks on most international currency, credit cards, etc. Cat. ST-3043

NEW

$14.95

LED Stretch-Light

NEW

Ultra bright LED torch fitted with a unique stretch case that converts the light from a spot beam to a small localised "table-lamp" style beam, great for camping, map reading etc. It features a push on/off switch a pocket clip and lanyard. 3AAA batteries included. Cat. ST-3075

$14.95

LED Illuminated Whistles

Ravers and niteclubbers will relate to these – but have you ever seen an ILLUMINATED whistle! The translucent section of the whistle glows with an enchanting light and can be selected to flash at the press of a button. Chrome barrel & clear whistle 89mm length x 10mm diameter & supplied with an approximate 44cm ball lanyard chain.
RED Cat. ST-3093 **GREEN** Cat. ST-3094 **BLUE** Cat. ST-3095

NEW

$11.95ea

19" Pro Grade Rack Cases

These are professional units with phosphated steel coated with dark metallic grey enamel. The front panel is 3mm aluminium with extruded handles; the rear panel is aluminium as well. Inside features pre punched and tapped rails for mounting of pc boards etc.

1 UNIT Cat. HB-5120
WAS $78.95 SAVE $15
$63.95

2 UNIT Cat. HB-5125
WAS $105 SAVE $10
$95

3 UNIT Cat. HB-5130
WAS $119 SAVE $10
$109

Party Speakers

As the party progresses, so does the volume and, if you're unfortunate enough, damage to your beloved hi-fi speakers generally ensues! These rugged, low cost party speakers are designed to 'stand in' in the place of your expensive hi-fi speakers.
See cat. Page 216 for details.

12" model 100WRMS
Cat. CS-2512
$159ea

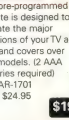
15" model 120WRMS
Cat. CS-2515
$209ea

Universal TV/VCR Remote

This pre-programmed remote is designed to operate the major functions of your TV and VCR and covers over 600 models. (2 AAA batteries required)
Cat. AR-1701
WAS $24.95

SAVE $5

$19.95



2.4Ghz Wireless A/V Transmitter With I/R Extender

See cat. page 230 for details

A powerful 10mW signal enables you to enjoy crystal clear reception of cable TV in a room away from the cable TV set top box! You can even use your cable TV remote control in another room as this unit includes a wireless repeater! Each unit comes complete with stereo audio and video transmitter and receiver, including AC power pack supplies. A special 6-way DIP switch is included to avoid interference with other units. Can also be used with VCR's, DVD, VCD, and CD players. **Cat. AR-1806**

Extra Reciever
It will allow you to receive the signal sent by the transmitter in another location. The transmitter can feed as many receivers as you like as long as they are within transmitting range. Includes the Infrared feature also. Cat. AR-1807

$239

$129

Video Intercom System

FANTASTIC NEW LOW PRICE

Consists of a small external unit that houses a black & white CCD camera, speaker & microphone. Built in infrared illumination lets you see visitors both day and night. Internal unit houses the 4" monitor, handset and control buttons. Doubles as a doorbell. When your visitor presses the button the bell sounds and the monitor switches on and you can talk to the caller. You can then even unlock the door remotely with our optional electric door strike (Cat LA-5078). Includes a 10m cable and plug pack power supply. Cat. QC-3412

Used to sell for $489

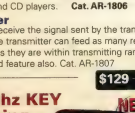
$299.50

250-450Mhz KEY FOB Learning Remote

NEW

Will learn up to 4 different codes. Use the same remote for your car, your partner's car and the automatic garage door with a spare button for the house alarm when you get it. Not suitable for code hopping alarms.
Cat. LA-8992

$49.95

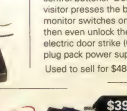


Tabletop Universal Remote Control

NEW

Unit includes 2 x AA Ni-MH batteries and features an LCD display with EL backlight with matching illuminated buttons. Size 167(L) x 180(W) x 50(H)mm. Power supply included. Cat. AR-1715

$399



Fantastic Car Tweeter Bargain

If you need that extra treble in your car sound system but don't want it to cost you much, these are for you. No mounting brackets are included but they do have a 6db crossover built in.
Cat. CS-2218

BARGAIN PRICE OF $7.95ea

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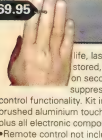
FREECALL FOR ORDERS 1800 022 888

Touch &/or Remote Controlled Light Dimmer

NEW

Refer: Sc Jan '02

$69.95



Features include slimline appearance, soft-start to extend lamp life, last dim setting stored, full brightness on second touch, RFI suppression and remote control functionality. Kit includes PCB, brushed aluminium touch plate, PIC micro plus all electronic components.

- Remote control not included - use our AR1703 ($21.95). Cat. KC-5324

JAYCAR KITS

PC Infrared Transceiver Kit

Ref: SC Dec 2001

Did you know that most PCs (and specifically, the Pentium-class motherboards) these days include infrared support out of the box? This quick-and-easy kit plugs into your motherboard to provide IR support for devices such as Notebook PCs, PDA Devices, Digital Cameras, Data Samplers Desktop PCs - and the list goes on.... Kit includes PCB plus all specified electronic components. Cat. KC-5323

$27.95

Low Cost AV Distribution Amplifier Kits

Composite Video

Jaycar exclusive

Ref: SC Nov 2001

Split an AV signal up to 6 ways without a great loss in quality. Great for presentations where multiple monitors are required. Kit includes case, PCB, silk screened & punched panels and all electronic components. 12VDC 60mA required – use our MP-3002 plugpack.Cat. KC-5320

S-Video

Ref: SC Nov 2001

Identical to KC-5320 but designed for S-Video signals instead: Cat. KC-5321

BOTH MODELS $139.95ea

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Was $69.95

Cat. KD-6066

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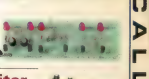
Light Alarm

SAVE $5

Was $14.95

Cat: KD-6010



$9.95

CD Audio Compressor

Was $83.95

Cat. KC-5291

SAVE $10

$73.95

Guitar Track Jammer

Was $33.50

Cat. KC-5301

SAVE $8

$25.50

2 Channel Guitar Preamplifier

Was $89.95

Cat. KC-5303

SAVE $20

$69.95

Bass Blazer Bargraph Display

SAVE $20

Was $89.95

Cat. KC-5305

$49.95

Off Hook Timer Kit

Was $24.95

Cat. KC-5314

SAVE $10

$14.95

12 Volt Stereo Amplifier Kit

SAVE $20

Was $95

Cat. KC-5311

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CFL Flourescent Lamp Driver

SAVE $40

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Cat. KC-5293

$49.95

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Cat. KC-5292 WAS $75

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SAVE $20

Was $44.95

Cat. KV-3514

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Cat. KV-3510

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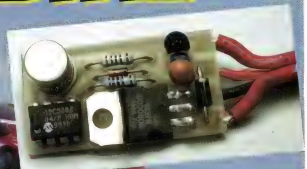
A cheap'n'easy MOTORBIKE ALARM

Design by
Mick Gergos*



With car manufacturers (finally!) getting smarter with security, motorbikes often make a "softer" target for thieves. Here's an alarm which is very simple to build, very simple to fit to almost any 'bike – and very easy to operate. Arming and disarming is done with the ignition key!

Many motorbikes today cost almost as much as – and often more than – a small car. Their value and their mobility makes them targets for thieves – whether joyriders (hate that word – there's no joy for the owner!) or professional crooks.

It's somewhat surprising then to find how few 'bikes are fitted with alarm systems. That's probably because alarms for bikes have been in the "too hard" basket – they are exposed to the weather (with all the problems that creates); they are vulnerable because they can't be hidden "inside"; they are too big for a small bike; you can't hide operating switches; you need to get at the wiring harness . . . and so on.

Here's a motorbike alarm which addresses all those problems and more. It's heatshrunk to protect it, it's tiny enough to be hidden just about anywhere, it doesn't need any external controls – and it suits virtually all 'bikes. As long as they have a battery and a headlight, this alarm should suit.

The alarm is "armed" automatically. When you turn the ignition off, you have 20 seconds to get off the bike. After this time, if anyone attempts to get on the bike or move it, they'll hear a series of warning "chirps" followed by four seconds of quiet. It's then in a "heightened alarm" state: touch it again within 30 seconds or so and the alarm screams its head off for 45 seconds!

If someone is still trying to interfere with the bike, the cycle will repeat three times (giving 3 x 45 second alarms). It won't keep continually going off because noise pollution laws in most states prohibit this.

If it is not touched again within the 30-second heightened alarm state, it goes "back to sleep" and waits for the next person to have a go.

To turn the alarm off while it is sounding, you simply turn the ignition key on then off. This resets and rearms the alarm. But what if you don't want the alarm on, for some reason?

That's easy: you simply turn the ignition key on and off twice – ie, on-off-on-off. This resets the alarm but disables it – and tells you with an acknowledgement "chirp".

Next time you turn the ignition on, you will reset the alarm again ready for use when the ignition is turned off again.

As you can see, operation is foolproof and all done with the ignition key – there are no hidden switches to worry about, no keypads to go faulty – nothing except the ignition switch. And if that goes faulty, you have a few more problems than an alarm that doesn't work!

The sensor

Two types of sensor are recommended – you can choose either or both if you want a belts-and-braces approach. The first is a non-position-sensitive motion detector which simply detects any movement of the bike. The second is a mercury switch, arranged as a "tilt" switch: when the "bike is on its stand, the mercury switch is positioned so it doesn't conduct. Take if off the stand, or move it in some other way and the switch does conduct.

Both of these switches are "normally open" types so, if you wish, you can fit one (or even more) of each type in parallel.

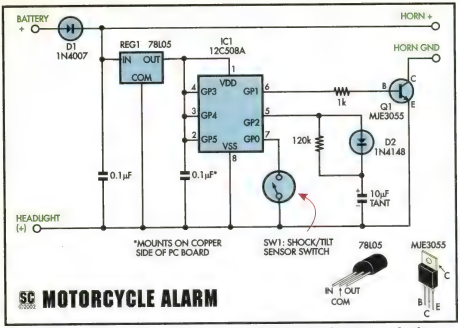
How it works

The circuit itself is very simple because, once again, a microcontroller does most of the work.

First, though, let's look at the supply. As you will note from the circuit, there is a connection to the '+' side of the 'bike's battery but no apparent connection to the '–' side. How come?

What would normally be regarded as the '–' or chassis connection is in fact connected between the light switch and the headlight. When the headlight is switched off, there is a low-resistance path (through the headlight filament) to chassis. If, say, the headlight is 50W, from Ohm's law we can work out that the resistance of the filament is about 3Ω (in fact it's much less than this when it is cold).

The complete alarm, shown with a small piezo siren which can be mounted anywhere on the bike with access to free air (so the sound isn't muffled). Just keep in mind that most piezos don't like water one little bit!



It couldn't be much simpler: just ten components make up the motorcycle alarm.

That amount of resistance to chassis won't affect the operation of this circuit at all.

If both the headlight **and** ignition are switched on, both supply lines are at the same potential, so the alarm is disabled.

Back to the supply again: it passes through a polarity-protection diode (just in case!), and then a 5V regulator to give IC1 the voltage it requires. It also goes direct to the horn or siren '+' side, with a hefty transistor, controlled by the microcontroller, switching its '–' side. This transistor is extreme overkill given the likely current of the horn or siren but this is one component you would not like to see go short circuit!

The output current switched by this transistor mustn't exceed 1A anyway, because that's the rating of the reverse-polarity protection diode. (Most piezo sirens would draw only a couple of hundred milliamps or so).

Every time the microcontroller is powered up, it looks for a "high" from its 1-bit external memory device (the 10µF tantalum capacitor). If it is not high, the PIC makes it high for three seconds, then makes it go low, which then goes to the "armed" routine.

Should the device be powered down during this 3-second period, the high would remain because the capacitor would stay charged. Next time the device is powered up, a high would be present. The microcontroller senses this and it goes into the "disarmed" routine.

The 120kΩ resistor and 1N4148 diode control the charging and discharging of the tantalum capacitor.

Construction

Because of the few components in this project, we're going to break one of our unwritten rules: as well as presenting it on a PC board, we're also going to show how to assemble it on Veroboard.

Yeah, yeah, we know. We don't like it much either because almost invariably, constructors manage to make a mess of it. But in this case, it really is so simple . . . but we'd suggest that if you have your druthers, we'd druther you use the PC board!

Which ever you choose, assemble the board in the normal way: lowest profile components first (resistors, diodes, etc), moving on to the capacitors, regulator, switch and finally the IC and power transistor. Note that the power transistor is secured to the Veroboard with a 3mm nut and machine screw – this forms the connection to the siren/horn "ground" track.

Before applying power, check and double check your component placement and orientation – most components are polarised so make sure you

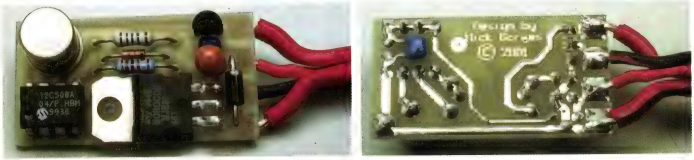
Parts List – Motorcycle Alarm

1 PC board, 38 x 20mm, code 05101021 (OR Veroboard, 10 tracks x 18 holes – see text)
1 60mm length 30mm heatshrink
1 cable clamp
1 motion detector switch AND/OR mercury switch – see text
1 piezo siren (Jaycar LA5225 or similar – see text)
Suitable lengths automotive wire

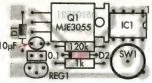
Semiconductors
1 12C508A pre-programmed microcontroller IC (IC1)
1 MJE3055 NPN power transistor (Q1)
1 78L05 low power 5V regulator (TO-92 package) (REG1)
1 1N4007 silicon power diode (D1)
1 1N4148 silicon signal diode (D2)

Capacitors
1 10µF 25VW tantalum electrolytic
2 0.1µF ceramic or polyester

Resistors (0.25W, 1%)
1 120kΩ 1 1kΩ

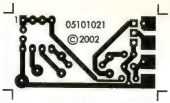


Front and rear photos of the assembled PC board. Note the 0.1µF capacitor on the back of the board. This board must be encased in heatshrink (or even mounted in a small box) to protect it from the elements, spray, etc.



TOP SIDE OF PC BOARD

UNDERSIDE OF PC BOARD



Component overlays for the top and bottom of the PC board, along with the board pattern itself reproduced same size.

get them the right way around.

The assembled board (PC or Vero) is "encased" in a length of heatshrink to give some protection from the elements and also to insulate the components from the 'bike. Before you do this, it's a good idea to check the circuit out and make sure it works!

It's probably easiest to check without installation, by simulating the bike using a 12V battery, a suitable switch and a hefty 12V globe. And you can simulate the alarm sensor with either a pushbutton switch or even a pair of wires to short. Connect them up as per the circuit diagram.

Remember when the alarm goes off the siren is going to be very loud. Just warning you!

OK, apply power. The voltage between pins 1 and 8 of IC1 should be very close to 5V. If not, check that you actually do have around 12V going in to the regulator.

Turn the "ignition" switch off and wait for 30 seconds. Now short the sensor contacts momentarily. You should hear a series of chirps from the siren, followed by silence. About ten seconds after the last chirp, short the sensor contacts again. The siren should now be sounding (we told you it was going to be loud!) and will continue to do so for about 45 seconds.

When it stops, short the contacts again and make sure the alarm sounds again.

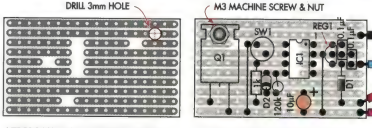
Now you'll be very pleased to turn the alarm off. Turn the ignition switch on then off again. The siren should go quiet. Thank heavens!

Check the disarm feature by repeating the above but when the siren sounds, turn the ignition switch on, off, on, off. The siren should stop and the you should hear a chirp, telling you the system is disarmed.

Installation

If all is OK, it's time to seal the circuit board in some heatshrink. The idea is to make it as weatherproof/waterproof as possible. Seal the open end of the heatshrink with a pair of pliers while it is still hot and place a cable tie on the other (cable) end, again while the heatshrink is still hot.

You need to find somewhere safe, out of sight and out of spray, to locate the alarm module. Most sirens also do not like water too much. Each bike is different so we'll leave that part up to you. Likewise the location of the sensor – choose where it will go carefully. If you are using only a mercury switch, you'll probably need to experiment a little to get a perfect angle.



The alternative layout on Veroboard. The easist way to cut the tracks is to use a 1/8in drill and twist the point in the appropriate place between the fingers. Practice on a scrap piece first and you'll get the idea!

Here's what it should look like once the heatshrink has been shrunk, gripped with pliers (on the left) and fastened with a cable clamp (on the right).

You want it to be reliable but you don't want false alarms when, for example, the bike is parked on a hill.

As far as the bike wiring is concerned, you only need to make two connections to the bike itself: to the unswitched battery supply and to the power line to the headlight, between the headlight switch and the lamp.

Try to add the wiring so that it is as undetectable as possible – you don't want a crook simply cutting wires.

Even though the currents involved are fairly small, we have shown heavy-duty automotive figure-8 cable in our photos. This has much better insulation than hookup wire. **SC**

Wheredyageddit?

■ **Preprogrammed 12C508A microprocessor:**
Available from Mr Mick Gergos, 13 Bunya Street, Bushland Beach, Qld 4818, for $25.00 plus $5.00 P&P

■ **Non-position-sensitive motion sensors:**
Available from Farnell Components (Cat 540-626) or RS Components (Cat 235-7566)

■ **Mercury switches (position sensitive) and piezo sirens:**
Available from Jaycar, DSE, Altronics, etc.

■ **PC boards:**
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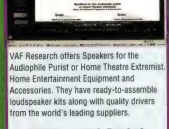

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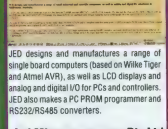

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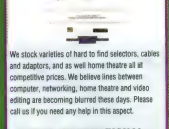

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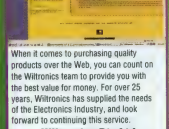

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Building the Ultra-LD 2 x 100W Stereo Amplifier

Part 3: By GREG SWAIN & LEO SIMPSON

In this final article, we continue with the assembly of the power supply and loudspeaker protector modules and give the full wiring details. We also describe the setting up and the test procedure.

Power Supply Board Assembly

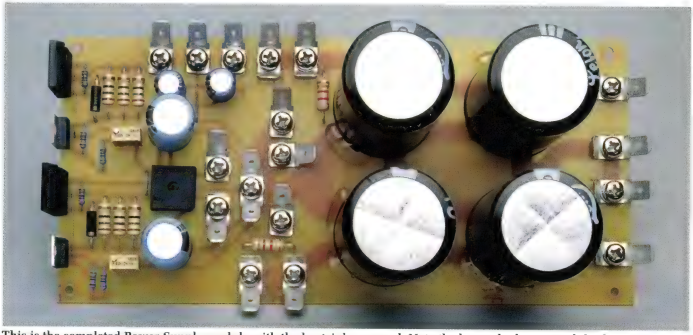
The next step is to build the Power Supply Module – see Fig.18. This board carries the four large 8000µF 63VW filter capacitors for the ±52.5V rails, plus all the parts for the ±55V regulated power supply.

Begin by installing the eight 1W resistors (6 x 15Ω and 2 x 8.2kΩ), mounting them all about 1mm proud of the board. This done, install the remaining resistors, diode bridge BR2, the wire links, the two multi-turn trimpots and the two zener diodes (ZD2 & ZD3). Make sure that BR1 and the zener diodes are correctly oriented.

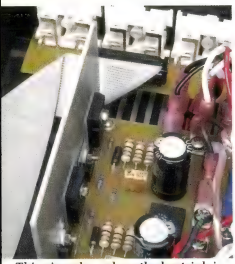
The male quick connects can be mounted next, followed by the electrolytic capacitors. Note that the two 470µF capacitors must be rated at 100VW – 63VW is not good enough since the input voltages to the positive and negative regulators are about +71V and -71V respectively.

Take extra care to ensure that the capacitors are installed with the correct polarity, especially the 8000µF units. Get one of these wrong and you'll soon know about it the first time power is applied.

The TIP33B transistors (Q17 & Q18) and the two 3-terminal regulators (REG1 & REG2) can now be bolted to the flat aluminium heatsink. These



This is the completed Power Supply module with the heatsink removed. Note the hot-melt glue around the four 8000µF filter capacitors – this prevents the cans from moving & placing stress on the solder joints.



This view shows how the heatsink is fitted to the Power Supply module. Note that all the devices must be isolated from the heatsink – see text.

devices must all be isolated from the heatsink using silicone washers and, where necessary, insulating bushes – see Fig.13 in Pt.2. Don't tighten the mounting screws just yet, though – that step comes after the assembly has been mounted on the PC board.

Note that the TIP33B (or TIP33C) transistors can came in either a TO-218 package (as shown in Pt.1, Fig.4, p29) or in a TO-3P package as used on the prototype. If you have the TO-3P package devices, then you don't need the insulating bushes. Conversely, if you have TO-218 package devices, the insulating bushes are required.

Make sure that you don't inadvertently swap REG1 & REG2 when attaching them to the heatsink.

The heatsink assembly can now be mounted on the PC board. Push the assembly down as far as it will go so that the plastic bodies of the regulators are about 3-4mm above the board surface and make sure that everything is square before soldering the leads. It's a good idea to tack solder a couple of leads on either side initially. That way, you can easily make any final adjustments before soldering the rest of the leads.

As before, use a multimeter to confirm that the device leads and metal tabs are all correctly isolated from the heatsink.

Hot-Melt Glue Time

As shown in the photographs, we applied hot-met glue fillets to the bottom edges of the four 8000µF capacitors. This stops the large capacitor

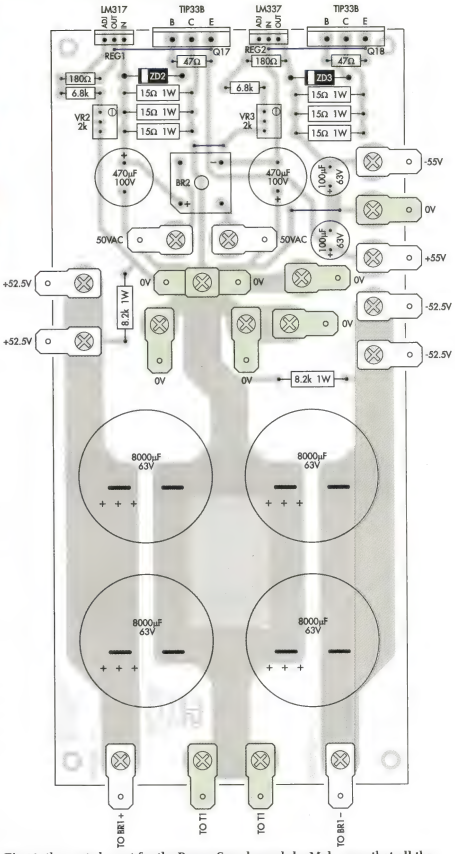


Fig.18: the parts layout for the Power Supply module. Make sure that all the electrolytic capacitors go in the right way around.

cans from moving and placing stress on the solder joints.

In short, the hot-melt glue treatment is a good idea but watch the hot tip of the gun – it's all too easy to damage the sleeving around one of

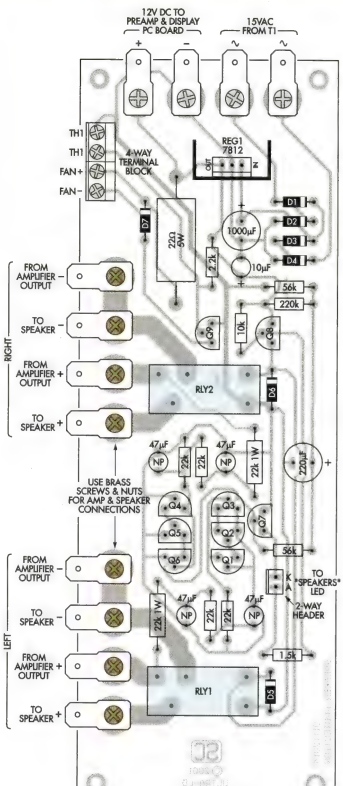


Fig.19: follow this parts layout diagram to build the Loudspeaker Protector module. Note that brass screws, nuts and star washers are used to mount the eight quick connect terminals for the amplifier and loudspeaker connects.

the large electrolytic capacitors if you're not careful.

Loudspeaker Protector & Fan Control Module Assembly

The last board to assemble is the Loudspeaker Protector & Fan Control Module. Fig.19 shows the details.

Mount the resistors and diodes first, then fit the male quick connects. Be sure to use brass screws, nuts and star washers to mount the quick connects for the eight loudspeaker terminals, as shown on the overlay.

Next, install the transistors, electrolytic capacitors and bipolar capacitors, taking care to ensure that the correct transistor type is fitted to each location. Note that the four 47μF bipolar capacitors can go in either way around but watch the orientation of the 10μF and 1000μF electrolytic capacitors.

Regulator REG1 is bolted to a micro-U heatsink (25 x 30 x 12.5mm) before it is soldered to the PC board. A thermal washer isn't necessary here since the heatsink doesn't touch any other components – just secure the regulator using a 6mm M3 screw, flat washer and nut.

The procedure for mounting REG1 is exactly the same as for Q8 & Q9 on the power amplifier modules – ie, insert the leads into the board, smear the mating face with thermal grease, attach the heatsink and push the assembly all the way down before soldering the leads and tightening the mounting screw.

Of course, you could fit the heatsink with the device off the board. However, if you do that, the heatsink will swivel when you attempt to tighten the mounting screw and you'll get thermal grease everywhere. Follow the steps outlined above and you'll end up with a much neater result.

Finally, you can complete the board assembly by fitting the two relays, the 2-way terminal blocks and the 2-way header.

By the way, our prototype board shows a couple of PC stakes in place of the pin header, which was a later refinement. Our final board also has four less quick connect terminals than the prototype board shown in the photographs. That's because we originally intended to drive the headphones via the Loudspeaker Protector Module. We later changed our minds and decided to drive the headphones directly from the Power Amplifier modules instead.

OK, now that all the PC board modules are completed, you're ready to mount them in the chassis and install the wiring.

Preparing The Case

As supplied, the case features a tough powder-coating that's also a good insulator. However, we must ensure that all sections of the case, including the side panels, lid and heatsink – are correctly earthed and that means ensuring they make good elec-

Use an oversize drill to remove the powder coating from under the screw heads, so that all sections of the case are correctly earthed (see text).

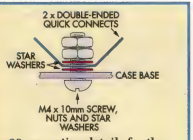


Fig.20: mounting details for the mains earth quick connects. The second nut locks the first nut, so there is no possibility of the earth lugs coming loose.

trical contact with each other.

There are two reasons for this: (1) all sections of the case must be connected to the mains earth to ensure safety; and (2) correct earthing is necessary to keep RF interference out of the audio circuitry.

The first job is to ensure that the side panels and the lid are earthed to the bottom section of the chassis. This is done by using an oversize drill to remove the powder coating from the countersunk screw holes (see photo). Use a drill that's slightly smaller in diameter than the screw heads and be sure to remove the powder coating right back to the bare metal.

Don't just do this for one or two holes – do it for all seven holes in each side panel and for all three holes in the lid. Provided you use a drill that's not too big, the bare metal will later be covered by the screw heads.

Next, scrape away the powder coating around the screw holes on the inside of the side panels, the underside of the lid and from the matching contact areas around the screw holes in the chassis. That way, when the case is assembled, earthing takes place via the screws themselves and via direct metal-to-metal contact between the various sections.

The transformer mounting bolt should also be earthed and this means that you have to remove some of the powder coating from around the mounting hole on the outside of the chassis (ie, from under the bolt head).

The front panel doesn't require any special preparation. Instead, it's later earthed by running a lead from a quick connect terminal that's welded to the panel back to the main chassis earth (see photo).

Don't attach the front panel to the chassis at this stage. Leave it wrapped up so that it doesn't get scratched or damaged in some other way. It doesn't

You need a ratchet-driven crimper

One essential item required to build this amplifier is a ratchet-driven crimping tool, necessary for crimping the insulated quick-connect terminals to the leads (except for the power transformer, which is supplied with quick connect terminals already fitted).

Suitable crimping tools include the Altronics Cat. T-1552, Dick Smith Electronics Cat T-3535 and the Jaycar TH-1829. These all feature double-jaws so that the bared wire end and the insulation are crimped in a single action.

Don't try to use one of the cheap (non-ratchet) crimpers that are typically supplied in automotive crimp kits. They are not up to the job for a project like this, as the amount of pressure that's applied to the crimp connections will vary all over the place. By contrast, the ratchet-driven crimpers apply a preset amount of pressure to ensure consistent, reliable connections.

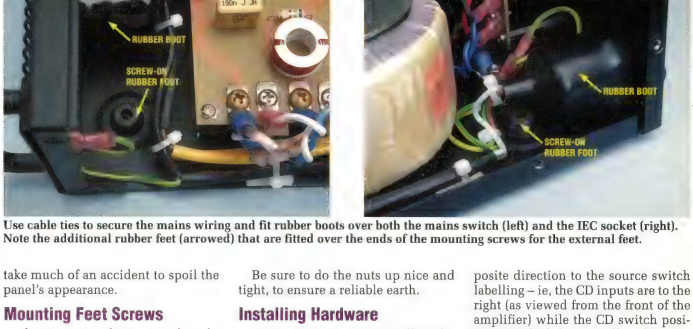
Table 1: Resistor Colour Codes

Power Supply Module

No.	Value	4-Band Code (1%)	5-Band Code (1%)
2	8.2kΩ	grey red red brown	grey red black brown brown
2	6.8kΩ	blue grey red brown	blue grey black brown brown
2	180Ω	brown grey brown brown	brown grey black black brown
2	47Ω	yellow violet black brown	yellow violet black gold brown
6	15Ω	brown green black brown	brown green black gold brown

Loudspeaker Protection Module

No.	Value	4-Band Code (1%)	5-Band Code (1%)
1	220kΩ	red red yellow brown	red red black orange brown
2	56kΩ	green blue orange brown	green blue black red brown
4	22kΩ	red red orange brown	red red black red brown
2	22kΩ	red red orange brown	red red black red brown
1	2.2kΩ	red red red brown	red red black brown brown
1	1.5kΩ	brown green red brown	brown green black brown brown
1	22Ω	red red black brown	red red black gold brown



Use cable ties to secure the mains wiring and fit rubber boots over both the mains switch (left) and the IEC socket (right). Note the additional rubber feet (arrowed) that are fitted over the ends of the mounting screws for the external feet.

take much of an accident to spoil the panel's appearance.

Mounting Feet Screws

The screws used to secure the rubber mounting feet protrude about 5mm into the chassis and could easily pierce the 26-way cable insulation on the righthand side. To prevent this, you can either remove the sharp ends of the screws using a Dremel tool or screw additional rubber feet over them.

Do the same for the mounting feet screws at the front-left and rear-left of the chassis. Admittedly, they pose no real danger to the mains wiring but it's best to make absolutely sure (see photos).

Chassis Earth Lugs

Fig.20 shows the mounting details for the main chassis earth lugs. This assembly consists of two double-ended quick-connect terminals which are bolted to the chassis using a 10mm M4 machine screw, two star washers and two nuts. The second nut on top is a "belts 'n braces" measure to lock the first nut, so that there's no possibility of the earth lugs coming loose.

Altronics has indicated that the earth lug mounting area in kit versions of the chassis will be free of powder coating. However, if this hasn't been done, you will have to remove the powder coating yourself. To do this, temporarily bolt one of the double-ended quick connects to the chassis and use a pencil to outline the contact area. The quick connect can then be unbolted and the powder coating removed using a a sharp implement or a Dremel tool fitted with a grinding bit.

Be sure to do the nuts up nice and tight, to ensure a reliable earth.

Installing Hardware

OK, you can now start installing the hardware in the case. Begin by mounting the IEC power socket, then smear the underside of the 35A bridge rectifier (BR1) with heatsink compound and bolt it to the chassis using an M4 screw, star washer and nut.

Fig.21 and the photos show BR1's mounting location. Orient it as shown, with its positive DC output at top left (as viewed from the front of the chassis).

The RCA input socket module can go in next and is secured from the rear of the chassis using three 6g x 10mm pan-head self-tappers. Don't overtighten these screws – you'll strip the plastic threads formed by the self-tappers if you do.

We initially mounted this board upside down (see page 23 of the November 2001 issue) but in the end decided to mount it component side up. This ensures that the board sits closer to the floor of the chassis and also makes it far easier to dress the 26-way connecting cable that plugs into the pin header.

The drawback (if you could call it that) is that the inputs run in the opposite direction to the source switch labelling – ie, the CD inputs are to the right (as viewed from the front of the amplifier) while the CD switch position is to the left. But really, who cares which way the inputs run? As long as the CD player is plugged into the CD inputs, the DVD player into the DVD inputs and so on, they will all be correctly selected at the indicated switch position.

TABLE 1: BOARD SPACERS

Preamplifier Board	4 x 20mm spacers + 4 x 3mm nuts
Power Amplifier Boards	2 x 25mm spacers
Power Supply Board	4 x 15mm spacers
Loudspeaker Protection Board	4 x 20mm spacers

Now for the loudspeaker terminals. Begin by cutting two 120mm lengths of figure-8 speaker cable and solder these to the two terminal panels – see photo. This done, fit the other ends of the leads with blue quick connects, then secure the two terminal panels to the chassis using four 6g x 12mm countersunk self-tappers.

Next, fit four 20mm tapped spacers to the Loudspeaker Protector module (use 6mm x M3 screws and washers) and secure it to the rear panel. Similarly, mount the Power Supply module in position on 15mm spacers but leave the top screws loose for the time being – this will make it easier to lift the board up to run leads under it later on.

Cable-Tie Mounts

As shown in one of the photos, the wiring is all secured to the floor of the chassis using cable-tie mounts and cable ties. Before installing the mounts, it's necessary to mark out their locations.

To do this, temporarily secure the power amplifier module in the chassis and use a pencil to mark these positions:

(1) the location of the heatsink and its three wiring channels;

(2) the locations of the individual amplifier boards;

(3) the locations of the PC tracks carrying the class-B currents from the paralleled 1.5Ω resistors on each side of the two boards; and

(4) the locations of the central earth tracks that run back to the 0V terminal from the two 1000μF capacitors (see Fig.21).

The reason for this is that it's important to correctly route the supply wiring under the power amplifier boards, to ensure the lowest possible distortion. The ±55V and 0V leads are routed directly under the earth track in the centre of each amplifier, while the ±52.5V leads radiate out at right angles beneath the tracks carrying the heavy class-B currents for the output stages.

Once you have everything marked out, remove the amplifier module and install cable-tie mounts at the following locations:

(1) on each side of the heatsink immediately opposite the three wiring channels.

(2) near the edge of the heatsink in line with the central earth track of the righthand power amplifier;

(3) at the central locations under the power amplifier boards where the ±52.5V leads branch off at right angles;

(4) on the floor of the chassis just inside the edges of the amplifier PC boards where the ±52V leads emerge to join onto their terminals;

(5) on the floor of the chassis, directly under the 0V terminals on the amplifier boards;

(6) directly under the centre two loudspeaker terminals of each amplifier board; and

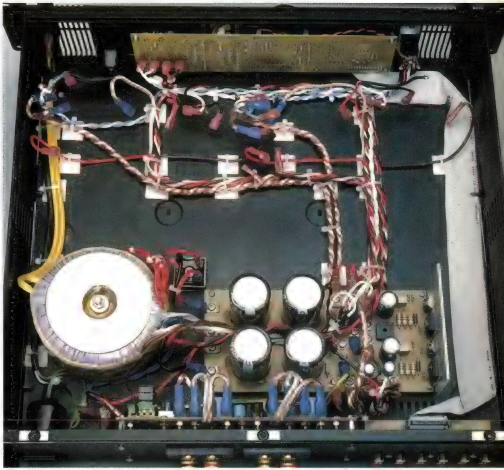
(7) directly between the two amplifier boards but with the central tie point clearing the front of the boards by about 5mm.

Additional cable-tie mounts are installed along the righthand edge of the chassis to further secure the mains wiring. These are located behind the power transformer and towards the front of the chassis.

The accompanying photograph shows the locations of most of the cable-tie mounts.

26-Way Header Cable

The next step is to fit the headers to the 26-way flat ribbon cable. First, cut the 26-way cable to exactly 550mm, then fit a header socket to one end by feeding the cable through and squeezing the assembly together in a vyce.



Use this photo and the wiring diagram of Fig.21 as a guide when placing the cable-tie mounts and installing the supply wiring.

There are a couple of points to note here:

(1) the lead with the red stripe must go to pin 1 of the header socket (indicated by a small arrow in the plastic moulding); and

(2) the cable must by fed through from the side opposite the arrow (ie, the end of the cable is on the side with the arrow).

Once the assembly has been "clamped" in the vyce, the cable is looped back over the top of the header and the strain relief clamp clipped into place.

The header at the other end is fitted exactly the same way. It's a good idea to test fit everything before fitting the second header – once the headers are clamped to the cable, they are virtually impossible to remove.

The cable can now be installed in the chassis. First, plug one end into the RCA input board, then fold the cable at right angles and then at right angles again so that it runs along the edge of the chassis (red stripe to the outside). The cable is then folded at right angles twice more at the front of the chassis, so that pin 1 of the header mates with pin 1 on the Preamplifier & LED Display module.

Preamplifier Mounting

Before mounting the Preamplifier & LED Display module, it's necessary to attach the shielded audio output leads. These audio output leads will probably be supplied as a length of figure-8 shielded cable. Cut the cable to a length of 210mm and lightly tin the leads (ie, the braids and the bared ends of the insulated wires) before securing them to the terminal blocks.

It's a good idea to fit a 10mm length of heatshrink tubing to the figure-8 cable at the terminal block end. That way, when the figure-8 cable is later separated (so that the leads can go to the power amplifier inputs), the heatshrink tubing prevents them from separating right at the Preamplifier end.

Fig.21: the loudspeaker cables and the DC supply leads to the Power Amplifiers account for most of the wiring. Route all cables exactly as shown, to ensure the lowest possible distortion from the Power Amplifier modules.

THESE 3 PAIRS PASS UNDER SECOND HEATSINK CHANNEL
ROUTE +55V CABLE AS SHOWN & POSITION EXACTLY AS SHOWN
LEFT CHANNEL
RIGHT CHANNEL
PREAMP & DISPLAY
HEADPHONE SOCKET
N.C.
FON
SPKR
INPUTS
OUTPUTS
LEFT SHIELDED CABLE
RIGHT SHIELDED CABLE
26-WAY IDC HEADER SOCKET
SPEAKERS LED
250VAC MAINS SWITCH (REAR VIEW)
FRONT PANEL EARTH POINT
GREEN/ YELLOW
NOTES:
1. THICK BLACK LINES DENOTE TWO OR THREE WIRES TWISTED TOGETHER FOR SPEAKER & AMP OUTPUTS, WHICH ARE SHIELDED CABLE.
2. REFER TO PHOTOGRAPHS FOR LOCATION OF CABLE TIE-DOWN POINTS.
3. INSTALL RUBBER BOOTS OVER THE REAR OF THE IEC MAINS SOCKET & THE MAINS SWITCH.

The rear panel of the amplifier carries the IEC mains socket, the loudspeaker terminals and the RCA input sockets.

This done, you can plug the input cable into the header pins and mount the Preamplifier & LED Display module on its standoffs. The insulated headphone socket can also be installed at this stage – it's mounted on the chassis "dimple" immediately to the left of the Preamplifier board, so that its front later sits flush with the front panel.

Wiring Up

Now for the internal wiring. It's not nearly as intimidating as it appears at first sight, since most of it consists of supply wiring to the power amplifier boards plus the loudspeaker wiring.

Note that all the supply leads and the loudspeaker leads should be tightly twisted together. This not only keeps the wiring neat but also minimises hum pickup since the hum fields are effectively cancelled out.

There's an easy way to twist leads together and that's by using a hand drill. All you have to do is secure one end of the leads in a vyce and the other end in the drill chuck. You then rotate the drill handle until you get a nice even twist along the full length of the leads.

Make the twists reasonably tight but don't overdo it – the wire will break through the insulation if you do. Once the leads have been twisted, trim the ends to remove any damaged insulation and fit quick connect terminals to one end only.

The leads at the other end are also later fitted with quick connect terminals after they have been run to their destination and cut to the correct length.

Fig.21 shows the wiring routes. Note that all the supply wiring goes through the lefthand wiring channel in the heatsink. The loudspeaker leads and the leads to the thermal switch go through the channel next to the fan.

Here are the leads that you have to run:

(1) Three twisted heavy-duty (7.5A) leads from the +52.5V, -52.5V and 0V connections on the Power Supply board to each Power Amplifier board.

(2) Three twisted heavy-duty leads from the +55V, -55V and 0V connections on the Power Supply board to each Power Amplifier board. Important: the power supply ends of one set of leads must be fitted with piggyback in-line quick connects. The other set of leads is fitted with "ordinary" quick connects which then plug into the piggyback terminals.

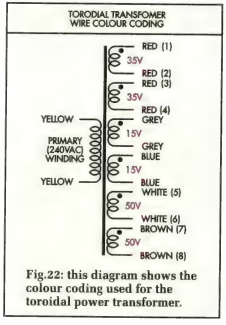


Fig.22: this diagram shows the colour coding used for the toroidal power transformer.

(3) Two twisted leads from the Loudspeaker Protector module to each of the Power Amplifier boards (use the heavy-duty 2 x 90/0.18 Whopper speaker cable fitted with blue quick connects).

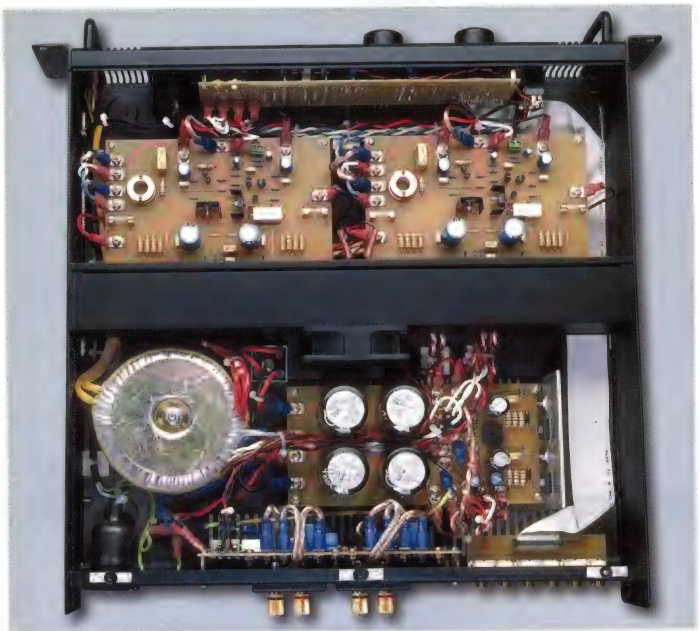
(4) Two twisted heavy-duty leads from the +12V and 0V terminals on the Loudspeaker Protector module to the +12V and 0V terminals on the Preamplifier module.

(5) Two twisted medium-duty leads from the 2-way header on the Loudspeaker Protector module to the headphone socket switch and from there to the "Speakers" LED on the front panel. These leads are fitted with a matching 2-way header plug at one end and are directly soldered to the headphone socket terminals and the LED leads at the other.

Fitting the 2-way header plug isn't difficult – just lightly solder and crimp the leads to the small header pins that are supplied, then push them down into the plug body until they lock into place.

(6) Two twisted medium-duty leads from the Loudspeaker Protector's TH1 terminals to thermal switch TH1 on the heatsink.

Once you've done all this, the power amplifier/heatsink module can be mounted in the chassis. The ends of the cables are then cut to length, fitted with quick connects and connected to



The powder coating must be removed from around the mounting holes that are used to secure the lid (and from matching contact areas on the lid itself).

the power amplifier boards, the thermal cutout and the preamplifier board.

The headphone socket wiring is next on the list. Route the leads slightly in front of the amplifier boards, along with the 15VAC and 12V DC wiring to the preamplifier. The leads can all then be secured using cable ties.

Finally, the amplifier wiring can be completed by connecting the shielded audio leads from the preamplifier to the screw terminal blocks.

Power Transformer Wiring

The toroidal mains transformer can now be bolted into position and its secondary leads connected. Note that the transformer is supplied with two neoprene rubber washers – one sits under the transformer while the other sits on top, with the metal cup washer stacked on the top of that.

The mounting bolt passes through the centre of the transformer and the assembly secured by fitting a nut to the top. Do the nut up firmly but don't overtighten it, otherwise you'll distort the metal chassis.

As mentioned last month, the transformer leads are all the correct length to reach their destinations and are pre-fitted with female quick connects. All you have to do is twist the various lead pairs together and plug them into the relevant quick connect terminals – ie, on BR1, the Power Supply module, the Loudspeaker Protector module and the Preamplifier & LED Display module.

It's important to connect the two 35V windings (red) with the correct phasing, otherwise you'll get 0V out of the bridge rectifier (BR1). This simply means connecting the leads as shown in Fig.21 – ie, leads 1 & 4 go to BR1, while leads 2 & 3 go to the two centre (0V) terminals on the Power Supply module.

The same goes for the two 50V windings (white & brown). Leads 5 & 8 go to the 50VAC terminals, while leads 6 & 7 go to the adjacent 0V terminals.

Two short leads fitted with quick

Parts List For Ultra-LD Stereo Amplifier

Hardware & Miscellaneous

1 custom-made rack-mounting case with heatsink & 80mm fan (case supplied drilled & with all cutouts made; heatsink supplied drilled, tapped & with channel cutouts in base)
1 front-panel (screened lettering)
1 heatsink for power supply
1 300VA toroidal power transformer, 2 x 50V, 2 x 35V, 2 x 15V secondaries
1 mounting kit for transformer
1 pushbutton DPST 250VAC switch (Altronics Cat. S3245)
2 knobs to suit rotary switch and potentiometer
1 IEC male power socket, chassis mount with insulating boot (Altronics P8324)
1 3A slow-blow M205 fuse
1 insulating boot for power switch
2 panel-mount gold-plated binding post terminal pairs (Altronics P2016)
1 6.35mm chassis-mount insulated stereo headphone socket (Altronics P0074)
1 pack 25 adhesive cable tie mounts (Altronics H4120)
50 100mm cable ties (Altronics H4012)
2 26-pin IDC in-line crimp sockets with strain-relief clips (Altronics P5326)
4 screw-on rubber feet (Altronics H0902

Preamplifier & LED Display Module

1 PC board, code 01112012, 246 x 166mm
1 26-way DIL pin header
2 2-way mini PC terminal blocks (Altronics P 2038) - 5mm pitch
1 2-pole 6-position switch (Altronics S 3022) (S1)
1 10kΩ 16mm stereo log pot (VR1)
2 F29 ferrite beads

Semiconductors

2 NE5534AN op amps (IC1,IC2) (Altronics Z2792 – do not substitute NE5534N)
1 TL072 op amp IC (IC2)
2 LM3915 display driver ICs (IC3,IC5)
1 7815 3-terminal regulator (REG1)
1 7915 3-terminal regulator (REG2)
2 1N4004 diodes (D1,D2)
4 1N914 diodes (D3-D6)
16 green thru-panel LEDs (LEDs 1-8, 11-18) (Altronics Z0711)
2 yellow thru-panel LEDs (LED9, LED19) (Altronics Z0713)
3 red thru-panel LEDs (LED10,LED20,LED21) (Altronics Z0710)

Capacitors

2 1000µF 25VW PC-mount electrolytics
2 100µF 25VW PC-mount electrolytics
9 10µF 35VW PC-mount electrolytics
4 10µF 50VW bipolar electrolytics
2 0.22µF MKT capacitors
2 0.01µF MKT capacitors
2 390pF ceramic capacitors
2 33pF ceramic capacitors
6 10pF ceramic capacitors

Resistors (0.25W, 1%)

2 680kΩ	2 2.2kΩ
2 330kΩ	2 1.8kΩ
2 220kΩ	3 1.2kΩ
2 150kΩ	4 150Ω
2 100kΩ	2 100Ω
2 82kΩ	2 33Ω
2 6.8kΩ	1 10Ω
2 4.7kΩ	

RCA Input Module

1 PC board, code 01112013, 110 x 32mm
3 2 x 2 PC-mount gold-plated RCA sockets (Altronics P 0214)
1 26-way DIL pin header

Power Amplifier Modules

2 PC boards, code 01112011, 176 x 108mm
8 M205 PC mounting fuse clips
4 M205 5A fuses
2 coil formers, 24mm OD x 13.7mm ID x 12.8mm long (Philips 4322 021 30362)
2 200Ω multi-turn trimpot, Bourns 3296W series (VR1)
3 metres 1mm diameter enamelled copper wire
4 micro-U heatsinks, 19 x 19 x 9.5mm (Altronics H 0630)
8 TO-3P insulating washers (silicone)
4 TO-220 insulating washers (silicone)
2 TO-126 insulating washers (silicone)
4 TO-220 insulating bushes
2 2-way mini PC terminal blocks – 5mm pitch (Altronics P 2038)
8 PC stakes

Semiconductors

4 Motorola MJL1302A PNP power transistors (Q13, Q14)
4 Motorola MJL3281A NPN power transistors (Q15, Q16)
2 Motorola or On Semiconductor MJE15030 NPN transistors (Q11)
2 Motorola or On Semiconductor MJE15031 PNP transistors (Q12)
2 Motorola MJE340 NPN power transistors (Q10)
2 BF469 NPN transistors (Q8)
2 BF470 PNP transistors (Q9)
6 BC546 NPN transistors (Q5-Q7)
8 BC556 PNP transistors (Q1-Q4)
2 3.3V 0.5W zener diodes (ZD1) – do not substitute 1W device

Capacitors

4 1000µF 63VW electrolytic
2 220µF 63VW electrolytic
2 100µF 63VW electrolytic
2 100µF 16VW electrolytic
2 2.2µF 25VW electrolytic
2 0.15µF 400VW MKC, Philips 2222 344 51154 or Wima MKC 4
10 0.1µF 63V MKT polyester
2 .0012µF 63V MKT polyester
2 100pF 100V ceramic

Resistors (0.25W, 1%)

4 18kΩ	2 330Ω

2 12kΩ 1W
2 3.3kΩ
2 2.7kΩ 5W
2 1.2kΩ
2 1kΩ
2 390Ω
2 330Ω 1W
4 220Ω 5W (for current setting)

4 150Ω
6 120Ω
8 100Ω
4 47Ω
2 10Ω
2 6.8Ω 1W
16 1.5Ω 1W

Miscellaneous
Heatsink compound, tinned copper wire for links, insulation tape

Power Supply Module

1 PC board, code 01112015, 199 x 93mm
2 2kΩ multi-turn trimpots, Bourns 3296W series (VR2,VR3)
1 drilled aluminium heatsink, 100 x 67mm (1.5-2.0mm thick)
2 TO-3P insulating washers (silicone)
2 TO-220 insulating washers (silicone)
4 TO-220 insulating bushes

Semiconductors
2 TIP33B NPN power transistors (Q17, Q18)
1 LM317 adjustable positive 3-terminal regulator (REG1)
1 LM337 adjustable negative 3-terminal regulator (REG2)
1 PA40 or KBPC3504 400V 35A bridge rectifier (BR1) (Altronics Z0091)
1 KBPC604 or PW04 400V 6A bridge rectifier (BR2) (Altronics Z0082)
2 33V 5W zener diodes (ZD2, ZD3)

Capacitors
4 8000μF 63VW chassis-mount electrolytic capacitors (Altronics R6720). Do not substitute Altronics R6722 as cans will foul chassis lid.
2 470μF 100VW electrolytics
2 100μF 63VW electrolytics

Resistors (0.25W, 1%)
2 8.2kΩ 1W
2 6.8kΩ
2 180Ω
2 47Ω
6 15Ω 1W

Loudspeaker Protector & Fan Control Module

1 PC board, code 01112014, 193 x 68mm
2 12V SPDT PC-mount relays, 16A contacts (Altronics S4197)
1 micro-U heatsink, 25 x 30 x 12.5mm (Altronics H0635)
1 thermal circuit breaker, 60°C, normally closed (TH1) (Altronics S5600)
1 2-way PC-mount pin header (Altronics P5492)
1 2-way header plug (Altronics P5472)
2 2-way mini PC terminal blocks – 5mm pitch (Altronics P2038)

Semiconductors
5 BC547 NPN transistors (Q1, Q3, Q4, Q6, Q7)
2 BC557 PNP transistors (Q2, Q5)
1 BC327 PNP transistor (Q8)
1 BC337 NPN transistor (Q9)
7 1N4004 1A 400V diodes (D1-D7)
1 LM7812 3-terminal regulator (REG1)
1 red thru-panel LED (LED1) (Altronics Z0710)

Capacitors
1 1000μF 25VW PC electrolytic
1 220μF 25VW PC electrolytic
4 47μF 50VW non-polarised PC electrolytic
1 10μF 35VW PC electrolytic

Resistors (0.25W, 1%)
1 220kΩ
2 56kΩ
4 22kΩ
2 22kΩ 1W
1 10kΩ
1 2.2kΩ
1 1.5kΩ
1 22Ω 5W

Wire & Cable

1m 250VAC 3-core mains flex
2m 2 x 90/0.18 figure-8 "Whopper" speaker cable
3m red heavy-duty (7.5A) hook-up wire
3m black heavy-duty (7.5A) hook-up wire
3m white heavy-duty (7.5A) hook-up wire
1m blue heavy-duty (7.5A) hook-up wire
1m green heavy-duty (7.5A) hook-up wire
250mm figure-8 shielded cable
2m red medium-duty hook-wire
2m black medium-duty hook-up wire
100mm 3mm-dia heatshrink tubing
100mm 5mm-dia heatshrink tubing
750mm 26-way IDC cable (Altronics W 2626)

Screws & Nuts

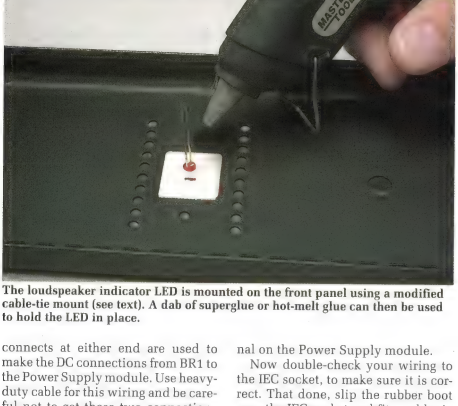
4 25mm tapped brass spacers
8 20mm tapped brass spacers
4 15mm tapped brass spacers
1 M4 x 16mm screw
42 M4 x 10mm screws
43 M4 nuts
100 M4 star washers
12 M4 x 10mm brass screws
12 M4 nuts
12 M4 star washers
24 M3 x 10mm screws
40 M3 x 6mm screws
15 M3 nuts
50 M3 flat washers
10 M3 star washers
3 6g x 10mm pan head self-tappers (to secure RCA socket pairs to chassis)
4 6g x 12mm countersunk screws (to secure the loudspeaker terminal pairs)
2 No.4 x 9mm universal head self-tapping screws (to secure IEC mains socket) (Altronics H1139)

Quick Connects

53 doubled-ended male quick connects (Altronics H2261)
50 red female in-line quick connects, 6.3mm (Altronics H2001A)
25 blue female in-line quick connects, 6.3mm (Altronics H2006A)
3 red piggyback in-line quick connects, 6.3mm (Altronics H2011A)

Where To Buy A Kit Of Parts

A complete kit of parts for the Ultra-LD 2 x 100W Stereo Amplifier will be available from Altronics, 174 Roe St, Perth. Phone (08) 9328 1599. You can order on-line from *www.altronics.com.au*



The loudspeaker indicator LED is mounted on the front panel using a modified cable-tie mount (see text). A dab of superglue or hot-melt glue can then be used to hold the LED in place.

connects at either end are used to make the DC connections from BR1 to the Power Supply module. Use heavy-duty cable for this wiring and be careful not to get these two connections transposed.

Once all the leads have been connected, they can be anchored by fitting the cable ties. Additional cable ties can also be fitted at various points between the cable-tie mounts, to keep the wiring tidy.

Mains Wiring

Take extra care with the mains wiring – it must be installed exactly as shown in Fig.21.

The best place to start is at the IEC socket end. Begin by stripping about 100mm of the outer sheath from the mains cable, then feed the brown and blue leads through the rubber boot that comes with the IEC socket. That done, crimp red quick connects to the ends and connect the Active (brown) and Neutral (blue) leads to their respective IEC socket terminals. The Earth lead (green/yellow) from the mains cable goes directly to the chassis earth – see Fig.21.

A second green/yellow mains-rated earth lead (about 240mm long) connects the earth terminal on the IEC socket to a chassis earth. Be sure to also feed this lead through the rubber boot before fitting quick connects to both ends.

The third chassis lug is connected via a 250mm-long lead to a 0V terminal on the Power Supply module.

Now double-check your wiring to the IEC socket, to make sure it is correct. That done, slip the rubber boot over the IEC socket and fit a cable tie to the leads as close to the boot as possible (this prevents the boot from coming off).

Additional cable ties can now be used to secure the wiring and to secure the mains cable to the cable-tie mounts. You will find this job easier with the side panel removed.

Important: you must secure the mains cable so that it is well clear of the self-tapper screws that are used to secure the side panel. In particular, note that the mains cable sheath should start well forward of the bottom rear self-tapper (see photo). This will allow the leads to be routed well away from this self-tapper and secured using cable ties.

Note also that the righthand heatsink channel has been positioned so that the heatsink mounting screws cannot possibly penetrate the mains wiring. The channel position also ensures that the leads take a natural path so that they clear the self-tapper that's just in front of the heatsink.

WARNING!

All transistors with "MJL" and "MJE" type numbers in the power amplifiers (ie, transistors Q10-Q16) must be genuine Motorola or On Semiconductor devices.

Do NOT substitute devices from other manufacturers – they do not have the same characteristics as the specified devices and can cause instability.

Speaker LED Mounting

The Speaker LED mounts directly on the front panel and the best way to go about this is to hold it in place using a modified cable-tie mount.

First, drill a 5mm hole in the top of the cable tie mount, then use a sharp knife to cut a clearance hole in the adhesive contact area (leave the backing paper in place during this procedure). The cable-tie mount is then affixed to the front panel (directly in line with the LED Speaker hole), the LED pushed in and a dab of superglue or hot-melt glue used to hold it in place.

Don't try using superglue to attach the LED directly to the front panel – it's all too easy to make a mess and spoil the panel's appearance. Hot-melt glue won't work here either because it doesn't adhere properly to the powder-coated surface..

Once the glue is try, the leads from the headphone socket can be soldered directly to the LED. Cut the LED leads short, so that they cannot foul other parts on the preamplifier board.

Mains Switch Wiring

Now for the mains switch wiring. This switch should be mounted on the front panel with terminals 1a and 2a towards the top. It's then simply a matter of cutting a 10mm-long slit in the back of the protective boot, feeding through the various leads and connecting them to the terminals.

This done, the protective boot is pushed over the switch body (it's a tight fit) and is secured by fitting cable ties to the wiring. The earth lead from the mains cable connects to an earth lug on the front panel (note: the front panel is supplied with this earth lug attached).

Leave enough slack in the switch wiring so that the front panel can be opened out to provide access to the nut that secures the volume control pot. Also, take great care not to scratch the front panel when working on the amplifier. It's supplied wrapped in bubble plastic and this makes a handy "mat" to lay the front panel on when it's detached from the chassis.

All wired up and ready for action – use cable ties to secure the transformer secondaries and other wiring to the Power Supply module.

Once all the switch wiring has been completed, the front panel can be slipped over the LEDs and fastened in position. Don't forget to fit the earth lead.

Switching On The First Time

Don't do it – at least, not yet. There's a step-by-step power-up sequence that must be observed, so that something doesn't fry.

Before applying power, check that the 8000μF and 470μF electrolytic capacitors on the Power Supply module are all correctly oriented and that the connections to BR1 are correct. Electrolytic capacitors have a very nasty habit of exploding if installed the wrong way around or if power is applied with reverse polarity.

Basically, you have to go through three main procedures to power up and adjust the amplifier: (1) check that the power Supply Module is delivering the correct voltages; (2) apply power to each of the Power Amplifier modules in turn and adjust the quiescent current; and (3) apply power to the Preamplifier and Loudspeaker Protection modules.

Here's the full step-by-step procedure:

STEP 1: disconnect all the ±52.5V & ±55V leads from the Power Supply module, the 15VAC leads from the Loudspeaker Protector module and the 15VAC & 12VDC leads from the Preamplifier module.

STEP2: connect an IEC power cord to the amplifier and use a multimeter to check for continuity (ie, 0Ω) between the earth pin of the plug and chassis earth.

STEP 3: install the 3A mains fuse in the IEC socket, apply power and check that the unregulated ±52.5V rails are correct (to within about a volt or so). Important: this should be done with the multimeter leads running out the back of the amplifier and with the lid sitting in place (this is a safety measure to protect your eyes in case something is wrong).

If the meter reads 0V, switch off immediately, recheck the connections to BR1 and check the phasing of the 35V transformer windings. If the phasing is incorrect, the two windings will operate in anti-phase and there will be no output voltage.

STEP 4: check the regulated ±55V rails using the procedure outline in Step 2. If you get "ballpark" figures (they won't

WARNING!

High DC and AC voltages are present on the Power Supply and Power Amplifier modules when power is applied. **In particular, make sure that you don't get across the two 50VAC terminals. The 50VAC transformer windings that connect to these terminals are wired in series, so there's 100V AC between them!**

Similarly, the two 35VAC windings are in series, so there's 70VAC between the AC terminals on bridge rectifier BR1.

In short, don't touch any of the high-voltage AC or DC (52.5V DC& 55V DC) terminals otherwise you could get a very nasty shock which could even prove fatal.

Preamplifier Modification

We recently discovered that our prototype Preamplifier board had a problem during wet weather, with some of the LEDs in the bargraph displays lighting when the amplifier was turned on from cold (ie, with no audio signal applied). The LEDs would then progressively go out over a period of several minutes.

This turned out to be due to moisture on the PC board, which was allowing leakage between the copper tracks. As the amplifier warmed up, the moisture evaporated and the LEDs behaved normally, even if the unit was switched off and then back on again.

The Altronics kit will be supplied with solder masked PC boards and this by itself should eliminate the moisture problem. However, we have decided to modify the circuit just to make sure.

The "cure" is to connect 82kΩ resistors between D3's cathode and ground and between D5's cathode and ground, to shunt this leakage resistance. We have modified the Preamplifier PC board to accept these extra resistors and this new board will be supplied with the Altronics kit.

Fig.22 shows the affected section of the PC board. The additional 82kΩ resistors are adjacent to pin 9 of each LM3915 display driver IC (IC3 & IC5).

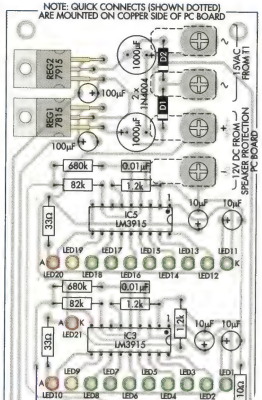


Fig.22 (left): the modified preamplifier board includes an extra 82kΩ adjacent to each LM3915 display driver IC.

be exact at this stage), the power supply is working OK although it's a good idea to wear safety glasses while making adjustments. Adjust trimpots VR2 & VR3 to obtain exactly ±55V DC.

Check the phasing of the 50VAC transformer windings if there is no voltage at the output of bridge rectifier BR2.

STEP 5: switch off and restore all the connections to the Power Supply module. Connect the ±52.5V & ±55V supply wiring to one Power Amplifier only. Disconnect all supply wiring from the other Power Amplifier.

STEP 6: remove the fuses and solder 220Ω 5W resistors between the two sets of PC stakes on the board. Now wind VR1 fully anticlockwise, apply power and check the voltage at the output of the amplifier (ie, the voltage between the loudspeaker terminals). It should be less than ±30mV.

If not, check the base-emitter voltages of the transistors; they should all be 0.6-0.7V. Check also that the correct transistor is installed at each location and that all transistors and other parts are the right way around.

STEP 7: monitor the voltage across one of the 220Ω 5W resistors and wind VR1 slowly clockwise until the meter reads 4.4V. This is equivalent to a quiescent current of 20mA (ie, 10mA through each output transistor).

Let the amplifier run for about 10 minutes, then readjust VR1 if necessary. Finally, switch off, remove the 220Ω 5W resistors and fit the fuses.

STEP 8: connect the ±52.5V & ±55V supplies to the second power amplifier and repeat steps 5 & 6 to set the quiescent current for this module.

STEP 9: connect the 15VAC leads to the Loudspeaker Protector module. Apply power and check that the relays turn on after about four seconds. Check that the Loudspeaker LED lights when the relays turn on and that the relays turn off when headphones are plugged in.

Next, check that the DC fault protection works by disconnecting the leads from one amplifier and connecting 3V DC (2 x 1.5V cells) between the terminals instead. Do the same for each channel – in each case, the relay should immediately turn off.

Now remove one of the leads from the thermal cutout (TH1) on the amplifier heatsink. Check that the fan immediately starts running and that it stops when the lead is reconnected.

STEP 10: check the +12V supply from the Loudspeaker Protector then switch off and connect the 15VAC and 12V DC leads to the Preamplifier module. Be sure to get the 12V leads the right way around – transpose them and smoke signals are guaranteed.

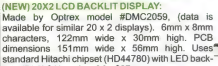
Apply power and check that the Power LED lights (the bargraph LEDs may also flash briefly). Check the outputs of the two 3-terminal regulators – you should get +15V from REG1 and -15V from REG2.

Listen To The Music!

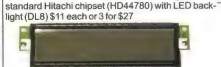
Now for the big moment. Connect your CD player and loudspeakers, switch on and listen with your ear close to the loudspeakers but without any music playing. Even with the volume control turned right up, there should only be a barely perceptible "hiss" from the speakers.

Finally, turn the volume control back to "normal", place your favourite CD in the tray, hit the "Play" button and sit back to enjoy the sound. Try varying the volume – you should see the bargraph LEDs "jump" up and down in response to the music. **SC**

(NEW) 40X2 Hyundai LCD's
These 40`2 LCD module are new and manufactured by Hyundai. Standard Hitachi chipset. No backlight. There is lots of information on the internet to drive these displays. PCB size is 180mm x 35mm and the window size is 160mm x 30mm. Check the following website for more information: http://www.allamerican.com/direct/results.asp?SHOW=50&MFG=_HYNL_ $25 each (limited quantity)



(NEW) 20X2 LCD BACKLIT DISPLAY:
Made by Optrex model #DMC2059, (data is available for similar 20 x 2 displays). 6mm x 8mm characters, 122mm wide x 30mm high. PCB dimensions 151mm wide x 56mm high. Uses standard Hitachi chipset (HD44780) with LED backlight (DL8) $11 each or 3 for $27



(NEW) OPTO 22 Relay I/O Module
These Relays are manufactured by APTech in Japan. AC Output is 24-280 VAC, with 5 VDC Logic. Check the following website for more information:. http://www.opto22.com/Ordering/ProductDrillDown.asp?IK=182\ $8 each

(NEW) BOPLA Card Enclosure System
These Bopla boxes (RCP-2500) are Brand New and are made of Polystyrene. Dimension is 214 X 257 X 128mm and are grey in colour with clear lid. Check the following website for more information http://www.bopla.de/katalog/index_en.html. (RCP-2500): $15 each

ROBOT BUILDERS BARGAIN!!!

RADIO CONTROL CAR / TRUCK REAR AXLE (DIFERENTIAL) ASSEMBLEY Complete assembly from a model car differential / gearbox and a 380 motor (Nom. 7.2V). The overall width is approx. 24cm. Good quality brand new unit as used in some Tandy electric cars. Manufacturing cost was around $30. We have a good quantity in stock for a small fraction of their retail price -$11 each.

NEW) SMALL SERVO MOTOR:
This is not a standard servo motor. It has a small motor, six wires and a feedback pot. The eedback pot is not connected o the motor. It draws about 00mA of current and runs from volts: (MS3) $4

BOSTON ACOUSTICS

$149

AS REVIEWED IN THIS MAGAZINE

MORE NEW STOCK FOR JANUARY!

We have more used test equipment. we need to clear some to make way for the next lot. But you may have already missed it. The only way to make sure you don't is to subscribe to our bargain corner & receive advanced notice. Just send us a blank E-Mail to.... bargaincorner-subscribe@oatleyelectronics.com

CAMBRIDGE SOUNDWORKS COMPUTER SPEAKERS
We have a limited quantity of these Cambridge SoundWorks GCS300 Computer Speakers. These are Brand New in original packaging that includes two speakers with power supply, cables, and manual. **Response:** 90 - 20kHz... **Amplifier Gain:** 12dB @ 1KHz volume max... **Output Power:** 92 dB SPL at .5m listening position... **Power (each satellite):** 2 Watt... **Input Impedance:** 10K ohms...**Controls:** On/off/master volume on right speaker...**Weight:** 1.5Kg per speaker set including adapter...**Dimension:**(153 X 101 X 114mm)... (GCS300): $22 - limited quantity.

ULTRA-VIOLET LEDS!!!

LEDS AND LASERS

395nM UV LED's...

200mCD	$4.70

Blue LED's

3.5CD	$3.50

White LED's

6CD	$2.50
10CD	$4
15CD	$6

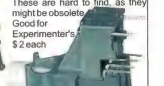
650nM LASER MODULES

3mW	$18
6mW	$36
10mW	$90
25mW	$200

BRAND NEW TELESCOPIC ANTENNAS
There are many different types but all have some kind of mounting. Some of the antennas also have swivels. Length ranges from 0.5 to 1.2 meter. We sell these in a mixed pack of 7 different types.

$5 per pack

(NEW) HP FIBRE OPTIC PORT
These HP Fibre Optic cable connectors (HFBR-1533) are made in Singapore. It is use as a connector between Fibre Optic cables and PCB's. It has 4 pins, possibly transceivers, and two pins for mounting to PCB's. These are hard to find, as they might be obsolete. Good for Experimenter's $ 2 each



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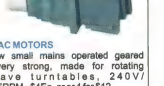

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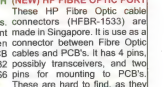

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SC_JAN_02

Tracking down software problems: a step-by-step approach

What's the first thing many people do when the strike computer problems? Answer: they reformat the hard disk and reinstall everything. But that's the hard way of fixing problems and it doesn't necessarily guarantee a good result.

By STEPHEN DAVIS

I vaguely remember having read somewhere that when someone asked Tesla how he was able to understand and invent complex electrical devices he replied: "By breaking the concepts underlying them down into simple parts, understanding those simple parts, and realising that complexity has an underlying simplicity".

An attitude like this prevents the mindset of being overwhelmed when confronted with problems that inevitably occur when using the complex technology of today. And of all the electronic devices that cause frustration, home computers would have to be right up there, along with setting up (and subsequently using) video recorders.

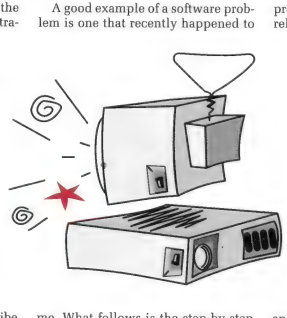
The added frustration that a home computer user has is that even the so-called professional's solution to a computer user's software problems is often destructive – ie, reformat the hard disk drive and start again or, at best, reinstall Windows from scratch. However, a little bit of knowledge and some careful analysis may be all that are required to save your PC's current setup from obliteration.

It often amuses me that some people who profess to be "au fait" with computers often describe themselves as software or hardware orientated and then shy away from gaining knowledge about that side of computers they feel doesn't interest them. This is a mistake, because if you are interested in solving computer related problems, a reasonable knowledge of both areas is necessary. After all, hardware faults can masquerade as software faults and vice-versa, so you have to be prepared to deal with both possibilities when troubleshooting.

The hardware and software in your PC is inexorably linked and this must be fully appreciated in order to solve problems as they arise.

A typical software problem

A good example of a software problem is one that recently happened to me. What follows is the step-by-step method that I used to solve the problem. You can use the same procedure to track down similar faults.



The problem occurred after I had foolishly installed several programs on my computer in quick succession. It is inadvisable to install programs in this fashion, because when software problems or conflicts occur, they are harder to track down – simply because you don't know which application introduced the fault.

This was a classic case of me not following my own advice and the problem occurred as a result of it. Everything seemed to be working well initially until, about a week later, I tried to fire up Microsoft Visual C++ (a component of Visual Studio) and found myself staring at an error message that said, "Msdev caused an invalid page fault in MFC42.dll". The program would then exit gracefully after my acknowledgement of the fault.

The first thing to do in a case like this is to go on to the Internet and, using a good search engine (I use Google at present), do a search for the above phrase. This has the potential of giving you an exact reason for your problem but in this case, nothing of relevance came up. I then searched the Microsoft Knowledge Base using the above phrase but again drew a blank.

Under these circumstances, the best thing to do is to uninstall and reinstall the program to see if this fixes the problem. The obvious disadvantage of this technique is that it does not aid in understanding why the fault was there to begin with. However, at the time, I was just eager to get the program going.

Unfortunately (or perhaps fortunately, otherwise this article would not have been written), the same error reared its ugly head and continued to do so no matter how often I uninstalled and reinstalled the program.

My next step was to uninstall all the programs I had installed subsequent to Microsoft Visual C++ working correctly. After doing this, I cleaned the Registry to delete any references to these programs that may have been

What's A DLL And How Do They Cause Problems?

So just what is a "dll" file and why do they sometimes cause problems? Since this explanation is for the layman and not for programmers, the following is a simplification of what actually occurs.

A "dll" is simply an enclosed set of different procedures that a program could call. For example, if I wish to save a file to disk from my program, I just simply call a set of instructions (a procedure) within a dll (in this case kernel32.dll) to do it. There are many dlls for many varied functions within Windows and programmers can also write their own dlls.

When computers first started becoming popular, all programs were self-sufficient, with the details of saving to disk, retrieving information, etc included within each program itself. However, it didn't take programmers long to realise that this was an inefficient way of doing things, because the same code for saving to disk would have to be included in every single program. Why not have the code required for saving to disk written separately, outside each program, so that all programs that save to disk could easily access it? This would save memory space and also the programmer's time.

All that the programmer would need to know would be that if he wants to save information to disk he simply writes 'savetodisk' or its equivalent, depending on what the original programmer called it. The operating system would then track down the dll containing this procedure and the procedure itself would start operating. Thus the code for saving to disk could be written to a separate module and linked to any program that required it – hence the concept of a linked library.

However, what if we were doing things on the computer that didn't require the "save to disk" procedure? Memory would be wasted holding code that was not going to be used. Hence the concept of a dynamic linked library (dll), where the actual calling of a procedure from a program is what first puts it into memory. Before it is called, it just sits as a file on the hard disk drive.

To explain how dlls can cause problems, imagine a programmer writing a simple piece of code for an arithmetic program aimed at elementary school children. The program introduces the concept of the squaring of numbers and because of the age group of the children, only integers can be used within the program.

Our programmer then turns this piece of code into a dll because he imagines other programmers may find this code useful for their own arithmetic programs. All they would have to do is link this piece of coding into their program and write "squarenumber" (depending on what the programmer called it) and they would get the required results – all based on the efforts of the programmer who originally wrote it.

Everything would be fine until someone decided to include this dll in a program for use by secondary schools where real and complex numbers are being explored. The programmer responsible for the dll would still like programmers to be able to write "squarenumber" and get a result and so he would put out version 2 of the dll, with the coding altered to give a result other than an integer when required.

So how would the dll know whether to deliver an integer result or not? The dll could look for certain bytes within memory that signify one version or the other of the program that uses it. The program would have assigned an area of memory for its own use in order to place the flag bytes and it would be the responsibility of the operating system to prevent this area of memory from being overwritten by another program.

Now imagine the case of a version 2 dll overwriting the original dll on a PC that uses the elementary program. The original program would not have reserved an area of memory for flag bits and so when the dll checks for these flag bits, a protection fault would result if this area of memory has been grabbed by another program.

Basically, the Windows operating system always preserves memory integrity by terminating programs that invade another program's reserved RAM.

This simplistic example explains how software conflicts can occur due to memory and dlls. It only takes a small piece of programming that is less than optimal to cause a cascade of problems that leads, at best, to the termination of one program or, at worst, to a complete crash.

left behind (I used the shareware program "Reg Vac" which has had good reviews on the Internet). I then reinstalled Visual C++ but the error was still present.

It was time to look at the error more closely by examining what it was saying.

What's a page fault?

A page fault is something that occurs normally with programs running under Windows. When a piece of information is paged out to virtual memory (the swapfile) on the hard drive (eg, due to lack of space in RAM), a page fault occurs whenever the RAM is accessed and the required information isn't there. The page fault then points the program to the area in the swapfile where the information is stored.

This information is then put back into RAM to allow it to be accessed by the data bus. At the same time, the least-used information currently in RAM is swapped out to virtual memory. An invalid page fault occurs when the area of swapfile that is required to be transferred back into memory is not valid for the application. Further information on this concept for people new to it can be found at: **http://www.howstuffworks.com/question175.htm**

MSDev.exe is the Microsoft development environment executable which, among other things, has to load MFC42.dll – a Microsoft foundation class dynamic linked library (see panel: "What's A DLL And How Do They Cause Problems?"). So it appeared that the error was occurring whenever MSDev.exe attempted to load MFC42.dll.

A Microsoft knowledge base article at **http://support.microsoft.com/support/kb/articles/q286/1/80.asp** talks

about the various causes of invalid page faults. The two that concern us here are the possibilities that either one of the two files is corrupted (and therefore allocating memory in an incorrect fashion) or that they are interfering with each other because of a lack of synchronisation with respect to memory.

This latter possibility could occur if the dll being used was the wrong version. Neither scenario seemed particularly likely considering that the Visual C++ had been installed and uninstalled many times already but I was running out of ideas.

As a result, I decided to install Visual Studio on a friend's computer, first to see if the CD itself had somehow become corrupted and second, to have a closer look at these two files.

Visual Studio worked perfectly on my friend's computer and so I copied both MSDev.exe and MFC42.dll onto floppies and took them home. I then compared these files with those on my hard disk drive and to my surprise, I found that the version of MFC42.dll in my hard drive's ***c:\windows \system*** directory was 6.00.8447.0 whereas the version on the floppy was 6.00.8141.0. So, it appears that a newer version of the dll had overwritten the older version (this is normal behaviour) but poor programming had resulted in a dll that was obviously not fully backwards compatible with the older one (as it should have been).

The next step was to replace the version of the dll in the system directory with the version of the dll that the program apparently needed. Using correct computer procedure (ie, the three "Bs" – backup, backup and backup), I tried to back up the version of MFC42 that was in the ***c:\windows\ system*** directory but I got an error saying, "Cannot delete MFC42.dll. Access denied. Make sure the disk is not full or write protected or that the file is not currently in use".

Suddenly a bell started ringing (actually more a mental buzz – the neurons were now firing). Obviously, my previous attempts at uninstalling and reinstalling Visual C++ would have had no effect on this file if it was being used by a TSR (a program that runs quietly in the background) – ie, the file could not be replaced or deleted while ever the TSR was running. However, it did annoy me somewhat to think that the programmer responsible for the uninstall routine of the Visual C++ module could have been a little more explicit in messages about which files were not being uninstalled.

Now that I knew what had happened, it was a simple matter of using the three-finger salute (ctrl-alt-del) to remove all of the background programs except for Explorer and Systray and then replacing one version of MFC-42.dll with the other. After rebooting

(to re-enable the TSRs), Visual C++ worked perfectly.

Norton's clobbered

It was now interesting to observe that the Norton Utilities portion of Norton System Works 2001 no longer worked. Instead, it simply displayed a very unhelpful message which said "Internal error".

Of course, replacing the Visual C++ version of MFC42.dll in the ***c:\windows\system*** directory with the other version (which I'd copied to another floppy) allowed Norton System Works to operate again – but at the expense of Visual C++.

I wanted both programs to work, so I thought about this problem and eventually decided to leave the dll required by Visual C++ in the ***c:\windows\ system*** directory and to place a copy of the other dll in the "Norton Utilities" folder where the executable for this "sub-unit" of Norton System Works was stored. In programming, there is often a sequence required for the program to find required files and usually the folder utilised by the executable itself is the first folder to be searched.

This type of programming methodology is exemplified by the "path" environmental variable utilised by DOS (ever heard of it?) during the dinosaur era. In this case, the idea paid off and I now have Norton System Works and Visual Studio happily coexisting with each other.

Be methodical

As the above story demonstrates, it's important to be methodical when tracking down software faults. A technique I have used in the past is to put pen to paper, list all the possibilities, and then methodically follow chains of logic.

I also frequently use the Internet to gain knowledge about the problem at hand. In the above case, I perhaps could have found the source of the problem sooner if I had done a search on keywords such as "MFC42.dll", problems, incompatibility, etc. I would have soon discovered that this dll is one of a number known to cause what is known as "dll hell" (do an Internet search using this little phrase and see what pops up).

Also, Norton Utilities is notorious, particularly in some of its earlier incarnations, for causing problems with other software. However, in this case, the problem is purely Microsoft's because MFC42.dll is a Microsoft file.

By now, some of you may be thinking that there is always a message at the start of most installation routines that says "Make sure other programs are not running during this installation routine" or words to that effect. Had I diligently followed this instruction and turned off all of the TSRs, the problem would not have happened.

My excuse for not following this instruction is that I had not thought deeply enough about it to consider applying this directive to background running programs – and I doubt that the majority of people installing programs would consider it either. However, doing things the long way, or sometimes the wrong way, is not something I necessarily regret if it gives me a greater understanding of my hobby.

And really, isn't that what its all about? **SC**

Make no mistake: this alarm sounds quite horrible. You don't build it to make pleasant sounds to lull you or someone else into a state of contentment. Build it to gain immediate attention. Build it and turn it on, only to hear someone say, "turn that b—dy thing orff!"

By THOMAS SCARBOROUGH

The inspiration for this circuit came from one of those doorbells that played the same tedious repertoire (eight tunes) over and over again. Why not, I thought, design a doorbell that would play an infinite variety of notes? Thus the idea for a random doorbell was born. But while the circuit described here will play about 20 million different sequences of notes on a single setting – most of them never previously combined, few people would actually want to use it as a doorbell, unless they were utterly tone-deaf.

It sounds pretty horrible, let me tell you.

Which is why this circuit rapidly "morphed" from a doorbell to a raucous alarm. It's now the alarm you build to get people's attention and then, because they will hate the sound it makes, they will do whatever is required to stop the alarm. And isn't that what you want an alarm to do?

Make it awful

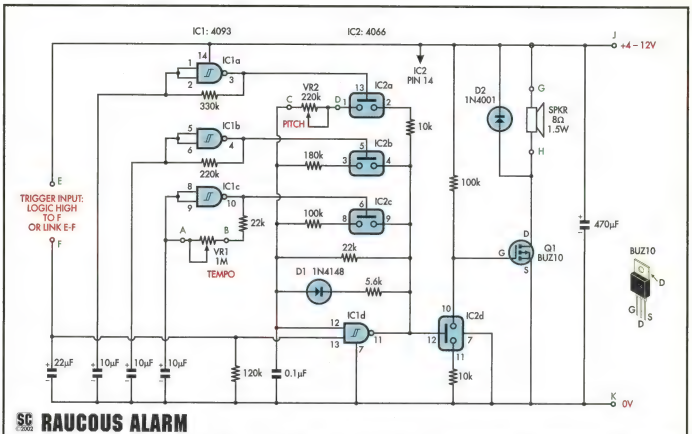
The key to designing an effective random alarm lies in creating a series of tones which not only sound unmusical in isolation but which are musically unrelated and then produced in a random sequence.

If too many random notes are played in too rapid a sequence, one begins to approach "white noise". If too few notes are played, or too slowly, the sound seems repetitive. The Raucous Alarm therefore plays eight notes in various sequences, and of varying duration, at a speed of about 150 beats per minute. This seemed to represent a good compromise.

The Raucous Alarm is based on an RC oscillator (IC1d). It CAN be seen from the circuit diagram (Fig.1) that five resistances (VR2 and R4-R7) are wired in parallel to make up the value of "R" – three of these being combined more or less at random.

Several resistors and capacitors set the pitch and duration of the Raucous Alarm's notes, and any one of these could be altered to change the "fundamental" sound. I chose to make just two of these components variable, with the aim of creating the maximum variation of sound with just two adjustments, for pitch and tempo. This means that there is a fairly wide scope for variation besides that already built into the "random" circuit.

The Tempo adjustment (VR1) sets the duration of four of the eight notes, while VR2 sets the amount of variation (or pitch) of the other four notes. Thus, the Raucous Alarm may be adjusted over a wide range of pitch and



SC ©2000 **RAUCOUS ALARM**

Fig.1: the circuit is based on a Schmitt trigger oscillator involving IC1d. Three other Schmitt trigger oscillators control analog switches (IC2) to rapidly vary the charging resistance for IC1d and thus rapidly vary the frequency.

tempo – all of which can sound pretty raucous, something like fiendish arpeggios played by a demented musician.

Circuit description

The Raucous Alarm makes very economical use of just a few simple components. The "economy" of this design is achieved by harnessing each of the circuit's two ICs to fulfil more than one function.

IC1, a 4093 quad 2-input NAND gate package, provides an oscillator and timer and it determines the duration of the notes. IC2, a 4066 quad analog switch, determines the pitch of the notes and also provides a buffer for the oscillator. The result is a cheap and simple circuit which produces far more (ghastly) variety than one would expect from its apparent simplicity.

At the heart of the Raucous Alarm lies a simple RC oscillator, based on a 2-input NAND gate IC1d (see Fig.1). "R" is determined by five resistances wired in parallel, three of which are switched in and out of circuit "at random" by IC2a-IC2c. One of these three resistances is variable, so that more variety is added to the range of sounds produced.

Diode D1, in conjunction with the series 5.6kΩ resistor, reduces the mark-space ratio of the pulse waveform delivered from pin 11 of IC1d and this has the effect of reducing current consumption while still maintaining a high (raucous) level of sound.

Switched resistors

As already noted, three resistors are randomly switched in and out of the main oscillator circuit (IC1d) by analog switches IC2a-IC2c. Each of these analog switches is controlled by a separate oscillator, based on NAND gates IC1a-IC1c. Each of these oscillators uses a 10µF capacitor between the inputs and 0V while having different resistors to further "randomise" the duration of each switched "note". Potentiometer VR1 is used in conjunction with IC1c so that the switching time for IC2c can be varied over a wide range.

The fourth analog switch in the package, IC2d, actually functions as a buffer stage for oscillator IC1d. Or you could think of it as an inverter, so that each time the output of IC1d goes high, IC2d is switched to pull the gate of Mosfet Q1 low.

Q1 drives the 8Ω loudspeaker directly from the positive supply rail and since it is an inductive load, diode D2 is connected to damp the voltage spikes that would otherwise be produced each time the Mosfet switches off.

Once the Raucous Alarm has been powered up, the three oscillators based on IC1a-IC1c run continually "in the background" (that is, without being heard). When the pin 13 input of IC1d is pulled high, IC1d is enabled as an oscillator and so sound (plenty of it) is heard from the speaker. Our prototype was wired with the trigger input operated by a pushbutton, by the way.

When the pushbutton is pressed, just a slice of the Raucous Alarm's continual activity is played out loud. The instant that pin 13 of IC1d is pulled high, the associated 22µF capacitor is charged up, so that oscillator IC1d is activated. After removing one's finger from the pushbutton, the

22µF capacitor discharges through the parallel 120kΩ resistor, causing a delayed "shutdown" of the Raucous Alarm.

In its "background mode", the Raucous Alarm draws around 5mA and about 160mA (at 12V) when activated. Thus a 12V plugpack rated at 200mA (about 2.5W) would suit.

Taming the output

The Raucous Alarm is very loud (nearly 2W RMS into a 8Ω speaker with a 12V DC plugpack) and will easily be heard throughout an entire home – if not by the neighbours as well!

This may be reduced by wiring a resistor in series with the loudspeaker – a 220Ω 0.5W resistor will make it bearable.

The alarm may also be quietened considerably by reducing the supply voltage down to as little as 4V or 5V, although this also lowers the pitch of the notes. Another thing to note is that the DC supply to the alarm should be the same as that of any external circuit which provides the trigger signal. So if it is to part of an alarm system which runs from 6V for exam-

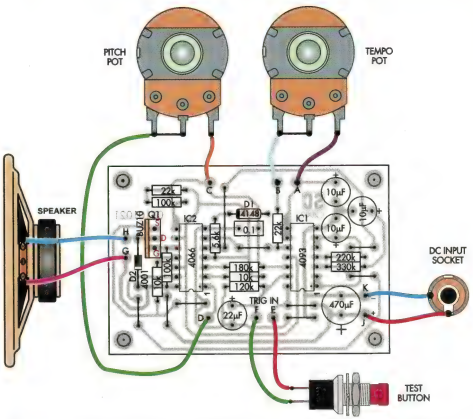
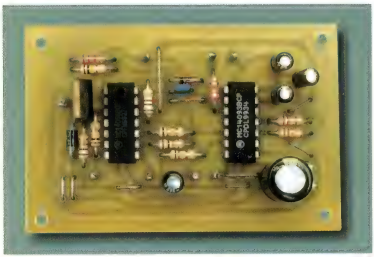


Fig.2: you can build this alarm as simply as you wish. Here we show it wired up with Tempo and Pitch controls and a pushbutton to sound it. Be warned - it is surprisingly loud when run from a 12V DC plugpack.



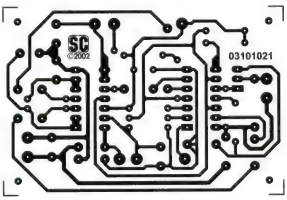


Fig.3: above is the full-size etching pattern for the PC board, while at right is the board with all the parts installed. Note that this prototype board differs slightly from that shown in Fig.2.

Resistor Colour Codes

❑	No.	Value	4-Band Code (1%)	5-Band Code (1%)
❑	1	330kΩ	orange orange yellow brown	orange orange black orange brown
❑	1	220kΩ	red red yellow brown	red red black orange brown
❑	1	180kΩ	brown grey yellow brown	brown grey black orange brown
❑	1	120kΩ	brown red yellow brown	brown red black orange brown
❑	2	100kΩ	brown black yellow brown	brown black black orange brown
❑	2	22kΩ	red red orange brown	red red black red brown
❑	2	10kΩ	brown black orange brown	brown black black red brown
❑	1	5.6kΩ	green blue red brown	green blue black brown brown

Parts List

1 PC board, code 03102021, 74 x 49mm
1 plastic case, 148 x 80 x 48mm, or equivalent
1 2.1mm chassis-mount DC power socket
1 12V 200mA DC plugpack with 2.1mm power plug
1 8Ω loudspeaker, rated at 2W or more
10 PC pins
2 14-pin dual-in-line IC sockets (optional)
1 on-off switch (optional)
1 pushbutton switch (optional)
1 1MΩ linear potentiometer (VR1)
1 220kΩ linear potentiometer (VR2)

Semiconductors

1 4093 quad NAND Schmitt trigger (IC1)
1 4066 quad analog switch (IC2)
1 BUZ10 Mosfet (Q1)
1 1N4148 diode (D1)
1 1N4001 diode (D2)

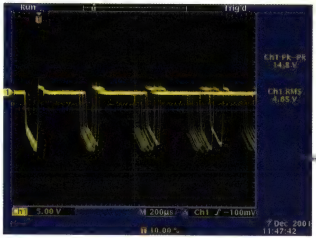
Capacitors

1 470µF 16VW PC electrolytic
1 22µF 16VW PC electrolytic
3 10µF 16VW PC electrolytic
1 0.1µF MKT polyester or monolithic

Resistors (0.25W, 5%)

1 330kΩ	2 100kΩ
1 220kΩ	2 22kΩ
1 180kΩ	2 10kΩ
1 120kΩ	1 5.6kΩ

If you measure across Mosfet Q1 with a scope, this is the sort of waveform you can expect to see. The jitter in the waveform is due to the rapid fluctuation (modulation) of the frequency.



ple, the Raucous Alarm should also run at 6V.

Construction

The PC board of the Raucous Alarm measures 74 x 49mm and it accommodates all the components apart from the speaker and the Tempo (VR1) and Pitch (VR2) controls. Note that VR1 and VR2 could be wired directly onto the PC board as trimpots or you could substitute fixed resistors once you have determined the values you want.

Construction is straightforward – just follow the wiring diagram of Fig.2 to assemble the board and wire the speaker, potentiometers VR1 & VR2, the (optional) pushbutton and the DC socket. Component values and types will make little difference, although ICs from Motorola (the MC14093BCP and MC14066BCP) are recommended.

If a BUZ10 is unavailable, any rough equivalent Mosfet such as an MTP-3055 or IRF610 can be used instead.

Begin by fitting the 10 PC pins, the nine wire links and then the resistors. Continue with the capacitors, diodes, Q1 and finally the CMOS ICs.

You can use sockets for the ICs if you wish. Note that the Mosfet and ICs are static sensitive and require appropriate handling (discharge your body to earth before handling these).

Our prototype was assembled into a plastic utility box measuring 148 x 80 x 50mm. This box comfortably accommodates the PC board, the small loudspeaker and the controls.

If you are using the same approach, you will need to drill holes in the lid to mount the potentiometers and pushbutton switch (if used). At one end of the case you will need to drill a hole for the DC socket and finally, you will need holes in the base of the case for the loudspeaker, to let the sound out.

The case can then be fitted with four adhesive rubber feet, so that the

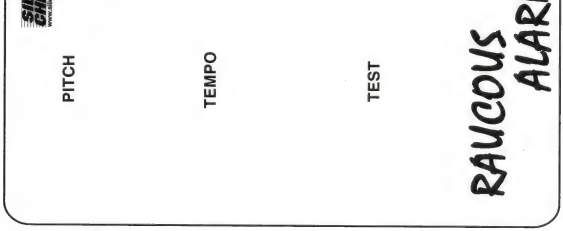


Fig.4: this full-size artwork can be used as a drilling template for the front panel of the Raucous Alarm.

sound can be clearly heard.

Once the PC board is complete, check your work very carefully, the connect the loudspeaker (solder pins G and H), pushbutton S1 (pins E and F) and the two potentiometers (pins A & B and C & D). Connect the DC socket to pins J & K, with its centre pin to positive (to pin I).

If desired, an on-off switch can be inserted in the positive supply line, or you can simply pull out the power plug when you wish to silence it.

Using it

No special setup is required for the Raucous Alarm. It is ready to go as soon as the power is plugged in. However, you might wish to begin as follows. First, turn the two front-panel potentiometers roughly to their mid-positions, then plug in a 12V 200mA (or greater) power supply. Note that the centre pin must be positive, otherwise damage could result. If in doubt, check this with a multimeter before plugging it in.

Now press pushbutton S1. Every press of the pushbutton should yield a different sequence of notes. Beware – the Raucous Alarm has an ear-piercing volume!

If the unit does not function as described, unplug the power immediately and recheck the wiring. Most faults are missed solder joints, diodes in the wrong way or shorts due to solder splashes on the copper side of the PC board.

Now experiment with front panel controls VR1 and VR2. VR1 adjusts the sound from a sedate to a lively warble, while VR2 alters the pitch of half of the notes, from sequences that sound something like standard scales, to much more varied arpeggios. **SC**

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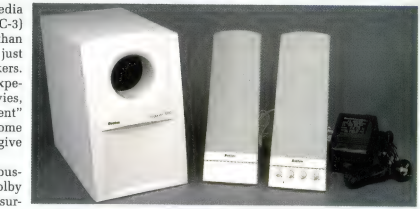
PRODUCT SHOWCASE

Boston Acoustics BA7500G Dolby Digital Speaker System



Looking for a real bargain? This multimedia speaker system with built-in Dolby Digital (AC-3) surround decoding normally sells for more than $500 but Oatley Electronics have them for just $150! That's a great price for a great set of speakers.

If you really want to boost your PC gaming experience or gain greater enjoyment from DVD movies, you need a decent speaker system. And by "decent" we mean something with a subwoofer to give some real bass rumble and Dolby Digital decoding to give realistic surround sound.

Originally made for Gateway, the Boston Acoustics BA7500G system provides true AC-3 Dolby Digital processing and outputs 5 channels of surround sound without requiring a separate amplifier or decoder. It consists of three loudspeakers: a subwoofer which also houses the Dolby Digital decoding circuitry and analog power amplifiers, plus two flat-panel satellite speakers.

The rear satellite speakers are not included and will have be purchased separately (but not from Oatley).

The subwoofer is housed in a cabinet measuring 299 x 178 x 372mm and features an 80mm (approx.) port in the front to augment the bass response. It uses a 165mm driver which is claimed to have a -3dB response right down to 45Hz.

Inside the subwoofer, a single PC board accommodates the Dolby Digital decoding circuitry plus two 4 x 12W TDA8561Q power amplifier ICs. Our bet is that one IC provides 2 x 24W channels for the front speakers, while the other provides 2 x 12W channels for the (optional) rear speakers and 1 x 24W bridged output for the subwoofer.

No power output figures are specified for the amplifiers, although the maximum sound pressure level (SPL) is listed as 107dB. Suffice to say, lack of power output is not a problem with this system. Turn the volume right up after dark and the neighbours will call the cops - that's if you don't mind putting up with the racket before they arrive.

The two satellite speakers slide onto neat little plastic stands to raise them of the desktop surface but can also be mounted on the walls (there are slots in the back of each speaker to let you do this). One of the stands includes the four volume controls: Master Volume, Surround Volume, Surround Balance and Subwoofer.

Digital drive

Unlike the BA7500s, the BA7500Gs require a digital signal input. This can come from the SPDIF output of your soundcard or from the digital output of a standalone DVD player. There are no analog inputs on the BA7500Gs, so if your soundcard doesn't have a digital output, you'll have to update.

Most decent soundcards now available, including recent Soundblaster Live cards, will have a digital output, so there are no worries on this score. Some computer CD-ROMs and DVD-ROMs also feature a digital output.

If no Dolby encoding is present, the system is capable of providing Virtual Dolby Surround sound. You can use this to enhance the sound from audio CDs if you wish. The system is also fully compatible with 4-channel sound cards (eg, for 4-channel games).

How do they sound? Well, they can really enhance your enjoyment of DVD movies by providing realistic sound effects with tonnes of bass – just like you get at the movies.

Admittedly, the BA7500Gs were originally designed to do with a PC but they also make a great speaker system for your lounge room.

Contact:
Oatley Electronics
PO Box 89, Oatley NSW 2223
Ph: 02 9584 3563 Fax: 02 9484 3561
www.oatleyelectronics.com.au

Australia's largest amateur radio & communications show next month

February 24th is the date for the Central Coast Amateur Radio Club's annual Field Day, which boasts to be the largest of its type in the Southern Hemisphere.

More than 2000 people from 40 clubs and organisations will converge on Wyong Racecourse to view, participate in, listen to, buy, swap and sell all facets of amateur radio, CB radio, shortwave listening and scanning, computer communications, project building, vintage and historical displays and of course, the famous flea market disposals areas (truckloads of pre-loved equipment!!) and trade/commercial shows.

Throughout the day there will be seminars and workshops covering many interesting subjects.

Some sites are still available – contact the organisers on 02 4340 2500 or via www.ccarc.org.au.

Gates open at 8.30am. There is plenty of off-street parking inside the Wyong Showground and refreshments are available on site. Entrance is $10 for adults, $5 for students, pensioners & seniors, with children under 12 free.

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Jaycar Electronics has long been a source of unusual and hard-to-get audio/video cables, accessories and adaptors for the electronics enthusiast and the company has expanded its range.

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Jaycar also carries a range of premium quality ready-made cables with gold-plated connectors and 100% shielded metal-body plugs. There are also twisted-pair audio cables that do not need to be shielded, perfect for up-market audio installations or anywhere a quality, durable, compact and attractive RCA cable is required.

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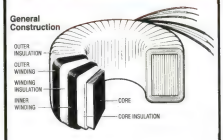

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Vishay's new Solid Niobium capacitors have "equivalent performance to tantalum"

Described as a technology breakthrough by Vishay Intertechnology, the company's research teams have created solid capacitors using niobium as the anode material.

Niobium is lower in density than tantalum and is also more readily available but until now a number or technical challenges have prevented its use – among these susceptibility to thermal and electric shock during manufacture.

The new capacitors are intended for filtering in mobile phones, PCs, DC-DC converter modules and a wide range of portable electronic systems. Voltage ratings are up to 10VDC with capacitance ranges from 10µF to 1000µF.

Vishay components are distributed in Australia by Support Components Pty Ltd.

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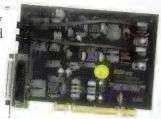
Broadcast quality PCI Audio Balancing Card

Broadcast specialists, Perth-based Elan Audio have introduced this PCI format balancing board which interfaces PC sound cards to professional sound systems.

The card is just one of the extensive range of broadcast and professional sound products from Elan Audio.

Further details may be obtained from the company's website.



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Website: www.elan.com.au

DECT cordless phones offer better clarity

Digital Enhanced Cordless Technology, the communication standard in Europe, is now available in Australia with the introdcution of two new Uniden DECT phones by Dick Smith Electronics.

Not only do DECT phones offer greater clarity, they are less prone to interference and unlike standard cordless phones, the call is secure. That is, it cannot be "eavesdropped" by anyone with a scanning receiver.

There are two new models – the $228 Uniden 1811 DECT (pictured) is a 10-channel phone which offers 10 hours of talk time and 200 hours of battery stand-by time (before it needs recharging). It has the capability of having up to five additional handsets connected to it. Calls can be transferred from handset to handset or it can be used as an intercom between handsets.

Also available is the $298 DORO DECT 360 which has a large LCD display and caller ID built in, along with additional features. Up to six handsets can be connected on this model.

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July 1989: Exhaust Gas Monitor; Experimental Mains Hum Sniffers; Compact Ultrasonic Car Alarm; The NSW 86 Class Electrics.

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October 1989: FM Radio Intercom For Motorbikes Pt.1; GaAsFet Preamplifier For Amateur TV; 2-Chip Portable AM Stereo Radio, Pt.2

November 1989: Radfax Decoder For Your PC (Displays Fax, RTTY & Morse); FM Radio Intercom For Motorbikes, Pt.2; 2-Chip Portable AM Stereo Radio, Pt.3; Floppy Disk Drive Formats & Options.

January 1990: High Quality Sine/Square Oscillator; Service Tips For Your VCR; Phone Patch For Radio Amateurs; Active Antenna Kit; Designing UHF Transmitter Stages.

February 1990: A 16-Channel Mixing Desk; Build A High Quality Audio Oscillator, Pt.2; The Incredible Hot Canaries; Random Wire Antenna Tuner For 6 Metres; Phone Patch For Radio Amateurs, Pt.2.

March 1990: Delay Unit For Automatic Antennas; Workout Timer For Aerobics Classes; 16-Channel Mixing Desk, Pt.2; Using The UC3906 SLA Battery Charger IC.

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June 1990: Multi-Sector Home Burglar Alarm; Build A Low-Noise Universal Stereo Preamplifier; Load Protector For Power Supplies.

July 1990: Digital Sine/Square Generator. Pt.1 (covers 0-500kHz); Burglar Alarm Keypad & Combination Lock; Build A Simple Electronic Die; A Low-Cost Dual Power Supply.

August 1990: High Stability UHF Remote Transmitter; Universal Safety Timer For Mains Appliances (9 Minutes); Horace The Electronic Cricket; Digital Sine/Square Generator, Pt.2.

September 1990: A Low-Cost 3-Digit Counter Module; Build A Simple Shortwave Converter For The 2-Metre Band; The Care & Feeding Of Nicad Battery Packs (Getting The Most From Nicad Batteries).

October 1990: The Dangers of PCBs; Low-Cost Siren For Burglar Alarms; Dimming Controls For The Discolight; Surfsound Simulator; DC Offset For DMMs; NE602 Converter Circuits.

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December 1990: 100W DC-DC Converter For Car Amplifiers; Wiper Pulser For Rear Windows; 4-Digit Combination Lock; 5W Power Amplifier For The 6-Metre Amateur Transmitter; Index To Volume 3.

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November 1991: Colour TV Pattern Generator, Pt.1; A Junkbox 2-Valve Receiver; Flashing Alarm Light For Cars; Digital Altimeter For Gliders, Pt.3; Build A Talking Voltmeter For Your PC, Pt.2.

December 1991: TV Transmitter For VCRs With UHF Modulators; Infrared Light Beam Relay; Colour TV Pattern Generator, Pt.2; Index To Volume 4.

March 1992: TV Transmitter For UHF VCRs; Thermostatic Switch For Car Radiator Fans; Coping With Damaged Computer Directories; Valve Substitution In Vintage Radios.

April 1992: IR Remote Control For Model Railroads; Differential Input Buffer For CROs; Understanding Computer Memory; Aligning Vintage Radio Receivers, Pt.1.

June 1992: Multi-Station Headset Intercom, Pt.1; Video Switcher For Camcorders & VCRs; IR Remote Control For Model Railroads, Pt.3; 15-Watt 12-24V Inverter; A Look At Hard Disk Drives.

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February 1993: Three Projects For Model Railroads; Low Fuel Indicator For Cars; Audio Level/VU Meter (LED Readout); An Electronic Cockroach; 2kW 24VDC To 240VAC Sinewave Inverter, Pt.5.

March 1993: Solar Charger For 12V Batteries; Alarm-Triggered Security Camera; Reaction Trainer; Audio Mixer for Camcorders; A 24-Hour Sidereal Clock For Astronomers.

April 1993: Solar-Powered Electric Fence; Audio Power Meter; Three-Function Home Weather Station; 12VDC To 70VDC Converter; Digital Clock With Battery Back-Up.

June 1993: AM Radio Trainer, Pt.1; Remote Control For The Woofer Stopper; Digital Voltmeter For Cars; Windows-Based Logic Analyser.

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August 1993: Low-Cost Colour Video Fader; 60-LED Brake Light Array; Microprocessor-Based Sidereal Clock; Satellites & Their Orbits.

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October 1993: Courtesy Light Switch-Off Timer For Cars; Wireless Microphone For Musicians; Stereo Preamplifier With IR Remote Control, Pt.2; Electronic Engine Management, Pt.1.

November 1993: High Efficiency Inverter For Fluorescent Tubes; Stereo Preamplifier With IR Remote Control, Pt.3; Siren Sound Generator; Engine Management, Pt.2; Experiments For Games Cards.

December 1993: Remote Controller For Garage Doors; Build A LED Stroboscope; Build A 25W Audio Amplifier Module; A 1-Chip Melody Generator; Engine Management, Pt.3; Index To Volume 6.

January 1994: 3A 40V Variable Power Supply; Solar Panel Switching Regulator; Printer Status Indicator; Mini Drill Speed Controller; Stepper Motor Controller; Active Filter Design; Engine Management, Pt.4.

February 1994: Build A 90-Second Message Recorder; 12-240VAC 200W Inverter; 0.5W Audio Amplifier; 3A 40V Adjustable Power Supply; Engine Management, Pt.5; Airbags In Cars – How They Work.

March 1994: Intelligent IR Remote Controller; 50W (LM3876) Audio Amplifier Module; Level Crossing Detector For Model Railways; Voice Activated Switch For FM Microphones; Engine Management, Pt.6.

April 1994: Sound & Lights For Model Railway Level Crossings; Discrete Dual Supply Voltage Regulator; Universal Stereo Preamplifier; Digital Water Tank Gauge; Engine Management, Pt.7.

May 1994: Fast Charger For Nicad Batteries; Induction Balance Metal Locator; Multi-Channel Infrared Remote Control; Electronic Dice; Simple Servo Driver Circuits; Engine Management, Pt.8.

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November 1994: Dry Cell Battery Rejuvenator; Novel Alphanumeric Clock; 80-Metre DSB Amateur Transmitter; Twin-Cell Nicad Discharger (See May 1993); How To Plot Patterns Direct to PC Boards.

December 1994: Easy-To-Build Car Burglar Alarm; Three-Spot Low Distortion Sinewave Oscillator; Clifford – A Pesky Electronic Cricket; Remote Control System For Models, Pt.1; Index to Vol.7.

January 1995: Sun Tracker For Solar Panels; Battery Saver For Torches; Dolby Pro-Logic Surround Sound Decoder, Pt.2; Dual Channel UHF Remote Control; Stereo Microphone Preamplifier.

February 1995: 2 x 50W Stereo Amplifier Module; Digital Effects Unit For Musicians; 6-Channel Thermometer With LCD Readout; Wide Range Electrostatic Loudspeakers, Pt.1; Oil Change Timer For Cars; Remote Control System For Models, Pt.2.

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October 1995: 3-Way Bass Reflex Loudspeaker System; Railpower Mk.2 Walkaround Throttle For Model Railways, Pt.2; Build A Fast Charger For Nicad Batteries; Digital Speedometer & Fuel Gauge For Cars, Pt.1.

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December 1995: Engine immobiliser; 5-Band Equaliser; CB Transverter For The 80M Amateur Band, Pt.2; Subwoofer Controller; Knock Sensing In Cars; Index To Volume 8.

January 1996: Surround Sound Mixer & Decoder, Pt.1; Magnetic Card Reader; Build An Automatic Sprinkler Controller; IR Remote Control For The Railpower Mk.2; Recharging Nicad Batteries For Long Life.

April 1996: Cheap Battery Refills For Mobile Phones; 125W Audio Amplifier Module; Knock Indicator For Leaded Petrol Engines; Multi-Channel Radio Control Transmitter; Pt.1.

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November 1996: 8-Channel Stereo Mixer, Pt.1; Low-Cost Fluorescent Light Inverter; Regenerative Nicad Battery Charger; Multi-Media Sound System, Pt.2; 600W DC-DC Converter For Car Hifi Systems, Pt.2.

December 1996: Active Filter Cleans Up Your CW Reception; A Fast Clock For Railway Modellers; Laser Pistol & Electronic Target; Build A Sound Level Meter; Multi-Media Sound Mixer, Pt.2; Index To Volume 9.

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March 1997: Driving A Computer By Remote Control; Plastic Power PA Amplifier (175W); Signalling & Lighting For Model Railways; Build A Jumbo LED Clock; Software For Networking PCs.

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September 1997: Multi-Spark Capacitor Discharge Ignition; 500W Audio Power Amplifier, Pt.2; A Video Security System For Your Home; PC Card For Controlling Two Stepper Motors On A Budget.

October 1997: Build A 5-Digit Tachometer; Add Central Locking To Your Car; PC-Controlled 6-Channel Voltmeter; 500W Audio Power Amplifier, Pt.3; Customising The Windows 95 Start Menu.

November 1997: Heavy Duty 10A 240VAC Motor Speed Controller; Easy-To-Use Cable & Wiring Tester; Build A Musical Doorbell; Replacing Foam Speaker Surrounds; Understanding Electric Lighting Pt.1.

December 1997: A Speed Alarm For Your Car; Two-Axis Robot With Gripper; Loudness Control For Car Hifi Systems; Stepper Motor Driver With Onboard Buffer; Power Supply For Stepper Motor Cards; Understanding Electric Lighting Pt.2; Index To Volume 10.

January 1998: Build Your Own 4-Channel Lightshow, Pt.1 (runs off 12VDC or 12VAC); Command Control System For Model Railways, Pt.1; Pan Controller For CCD Cameras; Build A One Or Two-Lamp Flasher, Understanding Electric Lighting, Pt.3.

February 1998: Multi-Purpose Fast Battery Charger, Pt.1; Telephone Exchange Simulator For Testing; Command Control System For Model Railways, Pt.2; Build Your Own 4-Channel Lightshow, Pt.2.

April 1998: Automatic Garage Door Opener, Pt.1; 40V 8A Adjustable Power Supply, Pt.1; PC-Controlled 0-30kHz Sinewave Generator; Build A Laser Light Show; Understanding Electric Lighting, Pt.6.

May 1998: Troubleshooting Your PC, Pt.1; Build A 3-LED Logic Probe; Automatic Garage Door Opener, Pt.2; Command Control For Model Railways, Pt.4; 40V 8A Adjustable Power Supply, Pt.2.

June 1998: Troubleshooting Your PC, Pt.2; Understanding Electric Lighting, Pt.7; Universal High Energy Ignition System; The Roadies' Friend Cable Tester; Universal Stepper Motor Controller; Command Control For Model Railways, Pt.5.

July 1998: Troubleshooting Your PC, Pt.3 (Installing A Modern And Solving Problems); Build A Heat Controller; 15-Watt Class-A Audio Amplifier Module; Simple 6V, 12V & 12V SLA Batteries; Automatic Semiconductor Analyser; Understanding Electric Lighting, Pt.8.

August 1998: Troubleshooting Your PC, Pt.4 (Adding Extra Memory); Build The Opus One Loudspeaker System; Simple I/O Card With Automatic Data Logging; Build A Beat Triggered Strobe; A 15-Watt Per Channel Class-A Stereo Amplifier.

September 1998: Troubleshooting Your PC, Pt.5 (Software Problems & DOS Games); A Bleeper For A Beam Alarm; A Dog Whistle Pedal For Your Guitar; Build A Plasma Display Or Jacob's Ladder; Gear Change Indicator For Cars; Capacity Indicator For Rechargeable Batteries.

October 1998: Lab Quality AC Millivoltmeter, Pt.1; PC-Controlled Stress-O-Meter; Versatile Open Up Guitar & Pops, Pt.1; Battery Charger For Float Conditions; Adding An External Battery Pack To Your Flashgun.

November 1998: The Christmas Star; A Turbo Timer For Cars; Build A Poker Machine, Pt.1; FM Transmitter For Musicians; Lab Quality AC Millivoltmeter, Pt.2; Versatile Open Up Guitar & Pops, Pt.2; Understanding Electric Lighting, Pt.9; Improving AM Radio Reception, Pt.1.

December 1998: Protect Your Car With The Engine Immobiliser Mk.2; Thermocouple Adaptor For DMMs; A Regulated 12V DC Puppet; Build Your Own Poker Machine, Pt.2; Improving AM Radio Reception, Pt.2; Mixer Module For F3B Glider Operations.

January 1999: High-Voltage Megohm Tester; Getting Started With BASIC Stamp; LED Bargraph Ammeter For Cars; Keypad Engine Immobiliser; Improving Audio Reception, Pt.3.

March 1999: Getting Started With Linux; Pt.1; Build A Digital Anemometer; 3-Channel Current Monitor With Data Logging; Simple 50V PIC Programmer; Easy-To-Build Audio Compressor; Low Distortion Audio Signal Generator; Pt.2; Electric Lighting, Pt.12.

April 1999: Getting Started With Linux; Pt.2; High-Power Electric Fence Controller; Bass Cube Subwoofer; Programmable Thermostat/ Thermometer; Build An Infrared Sentry; Electric Lighting, Pt.13.

May 1999: The Line Dancer Robot; An X-Y Table With Stepper Motor Control; Pt.1; Three Electronic Xmas Toys!, Heart Of LEDs; Build A Carbon Monoxide Alarm; Getting Started With Linux; Pt.3.

June 1999: FM Radio Tuner Card For PCs; X-Y Table With Stepper Motor Control; Pt.2; Programmable Ignition Timing Module For Cars, Pt.1; Hard Disk Drive Issues Without Reinstalling Software?

July 1999: Build A Dog Silencer; 10µH to 19.99mH Inductance Meter; Build An Audio-Video Transmitter; Programmable Ignition Timing Module For Cars, Pt.2; XYZ Table With Stepper Motor Control, Pt.3.

August 1999: Remote Modem Controller; Daytime Running Lights For Cars; Build A PC Monitor Checker; Simplex Temperature Controller; XYZ Table With Stepper Motor Control, Pt.4; Electric Lighting, Pt.14.

September 1999: Automatic Addressing On TCP/IP Networks; Autonomouse The Robot, Pt.1; Voice Direct Speech Recognition Module; Digital Multimeter Capacitance Meter; XYZ Table With Stepper Motor Control, Pt.5; Peltier-Powered Can Cooler.

October 1999: Build The Railpower Model Train Controller, Pt.1; Semiconductor Curve Tracer; Autonomouse The Robot, Pt.2; XYZ Table With Stepper Motor Control, Pt.6; Introducing Home Theatre.

November 1999: Electric Lighting, Pt.15; Setting Up An Email Server; Speed Alarm For Cars, Pt.1; Multi-Colour LED Christmas Tree; Build An Intercom Expert Loudspeaker System; Loudspeaker System For Musicians; Railpower Model Train Controller, Pt.2.

December 1999: Electric Lighting, Pt.16; Build A Solar Panel Regulator; The PC Powerhouse (gives fixed +12V, +9V, +6V & -5V rails); The Fortune Finder Metal Locator; Speed Alarm For Cars, Pt.2; Railpower Model Train Controller; Pt.3; Index To Volume 12.

January 2000: Spring Reverberation Module; An Audio-Video Test Generator; Build The Picman Programmable Robot; A Parallel Port Interface Card; Off-Hook Indicator For Telephone Lines.

February 2000: Multi-Sector Sprinkler Controller; A Digital Voltmeter For Your Car; An Ultrasonic Parking Radar; Build A Safety Switch Checker; Build A SineSquare Wave Oscillator; Marantz SR-18 Home Theatre Receiver (Review); The "Hot Chip" Starter Kit (Review).

March 2000: Resurrecting An Old Computer; Low Distortion 100W Amplifier Module, Pt.1; Electronic Wind Vane With 16-LED Display; Glowplug Driver For Powered Models; The OzTrip Car Computer, Pt.1.

May 2000: Ultra-LD Stereo Amplifier, Pt.2; Build A LED Dice (With PIC Microcontroller); Low-Cost AT Keyboard Translator (Converts IBM Scan-Codes To ASCII); 50A Motor Speed Controller For Models.

June 2000: Automatic Rain Gauge With Digital Readout; Parallel Port VHF FM Receiver; L/I Powerhouse Switchmode Power Supply (1.23V to 40V) Pt.1; CD Compressor For Cars Or The Home.

July 2000: A Moving Message Display; Compact Fluorescent Lamp Driver; 5-Chappo Miniature Lead Tester; L/I Powerhouse Switchmode Power Supply (1.23V to 40V) Pt.2.

August 2000: Build A Theremin For Really Eerie Sounds; Come In Spinner (writes messages in "thin-air"); Loudspeaker Protector & Fan Controller For The Ultra-LD Stereo Amplifier; Programmable Timer For 240VAC Lamps; Structured Cabling For Computer Networks.

September 2000: Build A Swimming Pool Alarm; An 8-Channel PC Relay Board; Fuel Mixture Display For Cars, Pt.1; Protoboards – The Easy Way Into Electronics, Pt.1; Chug The Magic Dice, & Pops, Pt.

October 2000: Guitar Jammer For Practice & Jam Sessions; Boxed Buster Breath Tester; A Wand-Mounted Inspection Camera; Installing A Free-Air Subwoofer In Your Car; Fuel Mixture Display For Cars, Pt.2; Protoboards – The Easy Way Into Electronics, Pt.2.

November 2000: Santa & Rudolf Chrissie Display; 2-Channel Guitar Preamplifier, Pt.1; Message Bank & Missed Call Alert; Electronic Thermostat; Protoboards – The Easy Way Into Electronics, Pt.3.

December 2000: Home Networking For Shared Internet Access; Build A Bright-White LED Torch; 2-Channel Guitar Preamplifier, Pt.2 (Digital Reverb); Driving An LCD From The Parallel Port; Build A Morse Clock; Protoboards – The Easy Way Into Electronics, Pt.4; Index To Vol.13.

January 2001: LP Resurrection – Transferring LPs & Tapes To CD; The LP Doctor – Click, Pop & Hum Reduction For Vinyl; Binary Waveform Generator; 2-Channel Guitar Preamplifier, Pt.3; PIC Programmer & TestBed; Wireless Networking.

February 2001: How To Observe Meteors Using Junked Gear; An Easy Way To Make PC Boards; L/I Pulser Train Controller; Midi-Mate – A MIDI Interface For PCs; Build The Bass Blazer; 2-Metre Elevated Groundplane Antenna; The L/I Controller – Code Dice, & Pops, Pt.3.

March 2001: Driving Your Phone From A PC; Making Photo Resist PC Boards At Home; Big-Digit 12/24 Hour Clock; Parallel Port PIC Programmer & Checkerboard; Protoboards – The Easy Way Into Electronics; Pt.5; More On Midi-Mate; MIDI Expander Project.

April 2001: A GPS Module For Your PC; Dr Video – An Easy-To-Build Video Stabiliser; A Tremolo Unit For Musicians; Minimitter FM Stereo Transmitter; Intelligent Nicad Battery Charger; Computer Tips – Tweaking Internet Connection; Pt.1.

May 2001: Powerful 12V Mini Stereo Amplifier; Microcontroller-Based 4-Digit Counter Modules; Two White-LED Torches To Build; PowerPac – A Multi-Voltage Power Supply; Using Linux To Share An Internet Connection, Pt.1; Computer Tips – Tweaking Windows With TweakUI.

June 2001: Fast Universal Battery Charger, Pt.1; Phonome – Call, Listen In & Switch Devices On & Off; L'il Snooper – A Low-Cost Automatic Camera Switcher; Using Linux To Share An Internet Connection, Pt.2; A PC To Die For, Pt.1 (Building Your Own PC).

July 2001: The HeartMate Heart Rate Monitor; Do Not Disturb Telephone Timer; Pic-Toc – A Simple Alarm Clock; Fast Universal Battery Charger, Pt.2; A PC To Die For, Pt.2; Computer Tips – Backing Up Your Email; Digital Amplifiers Are Here (Feature).

August 2001: Direct Injection Box For Musicians; Build A 200W Mosfet Amplifier Module; Headlight Reminder For Cars; 40MHz 6-Digit Frequency Meter; A PC To Die For, Pt.3; Using Linux To Share An Internet Connection, Pt.3.

September 2001: MP3 – Changing The Way You Listen To Music; Making MP3s – Rippers & Encoders; Build Your Own MP3 Jukebox; The Ultimate Loudspeaker Protector; Power Supply For Tesla Coil Sections; The Scope! Snooper Directional Microphone; Using Linux To Share An Internet Connection, Pt.4.

October 2001: A Video Microscope From Scrounged Parts; Build Your Own MP3 Jukebox, Pt.2; Super-Sensitive Body Detector; An automotive Thermometer; Programming Adapter For Atmel Microcomputers; Building Your Own PC – One Man's Approach.

November 2001: Ultra-LD 100W RMS/Channel Stereo Amplifier, Pt.1; Neon Tube Modulator For Cars; Low-Cost Audio/Video Distribution Amplifier; Short Message Recorder Player; Computer Tips.

December 2001: Is There A Hybrid Car In Your Future?; Windows XP – What's In It For You?; Build A PC Infrared Transmitter & Wireless LD 100W RMS/Channel Stereo Amplifier, Pt.2; Pardy Lights – An Intriguing Colour Display; PIC Fun And Games – Learning About Micros.

PLEASE NOTE: November 1987 to March 1989, June 1989, August 1989, December 1989, May 1990, February 1991, June 1991, August 1991, January 1992, February 1992, July 1992, September 1992, November 1992, December 1992, January 1993, May 1993, February 1996, March 1998 and february 1999 are now sold out. All other issues are presently in stock. For readers wanting articles from sold-out issues, we can supply photostat copies (or tear sheets) at $7.70 per article (includes p&p). When supplying photostat articles or back copies, we automatically supply any relevant notes & errata at no extra charge. A complete index to all articles published to date is available on floppy disk for $11 including p&p, or can be downloaded free from our web site: www.siliconchip.com.au

VINTAGE RADIO

By RODNEY CHAMPNESS, VK3UG

Philips Philetta & the Titan Tiny

This month, we publish a few more details on the intriguing Philips Philetta and take a close look at the Titan Tiny. The latter is a compact, hot-chassis set and is a real death-trap for the unwary.

The article on the Philips Philetta in the November 2000 issue sparked quite a bit of interest. In that article, I mentioned that I had not seen the circuit of this intriguing little set and Ross Paton of Auckland, New Zealand kindly sent a copy of the circuit and much of the technical data as originally supplied by Philips. The circuit diagram covers both the B3D32A and B3D33A models – the only apparent difference is the cabinet style.

It is interesting to see how the set achieved its various functions. As it turned out, my "guestimations" on how the set was engineered were quite close to the mark. It still pays to be cautious when making assumptions, though. For example, a number of radio manufacturers built generic sets for other companies. However, with a little experience, even an unlabelled set can often be identified – whether by the type of cabinet housing the set or how the chassis is wired or labelled.

Getting back to the Philetta, Ross reports that this set is typical of the many small table radios made by Philips from the late 1950s through into the 1960s. In fact, many were brought to Australia and New Zealand during this period by migrants.

According to Ross, the ECC85/6AQ8 RF amplifier valve is not particularly reliable in this set, as the valve is run with no high-tension voltage for lengthy periods when FM is not being received. This causes the cathode to become poisoned. If the 6AQ8 is unavailable, the 6BQ7A/ECC180 is worth considering as a replacement. It is pin-for-pin compatible but its inter-electrode capacitance is different and this upsets the alignment which has to be tweaked.

The various functions in the set are achieved by a large number of switch contacts and it is not a circuit that you can find your way around easily. On the other hand, it showed how a good-quality European set was put together.

The Titan Tiny was a basic compact 4-valve receiver designed for the bottom end of the market. It was housed in a white bakelite cabinet and has just two controls: a handspan tuning knob and a combined on-off/volume control.

The Titan Tiny

Now we go from discussing a well-designed and reasonably sophisticated receiver to a set that was designed for the bottom end of the market.

I was visiting Brian Lackie at Urunga on the north coast of NSW some time back and he showed me an intriguing little set called the Titan "Tiny" – and "tiny" it is. This set has yet to be restored, as can be seen from the various photographs. The front view shows a very plain small white Bakelite cabinet, with what appears to be a direct drive tuning control and an on/off switch/volume control (with its

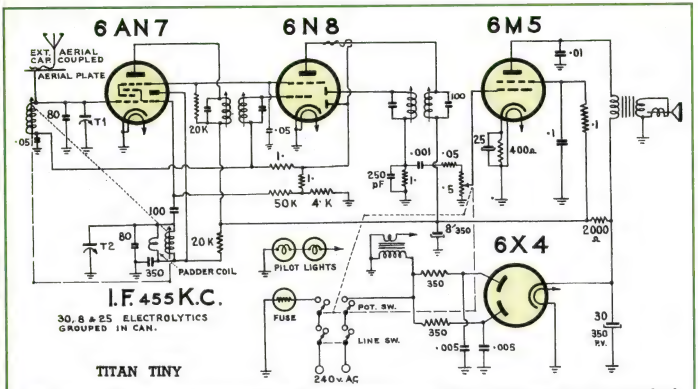


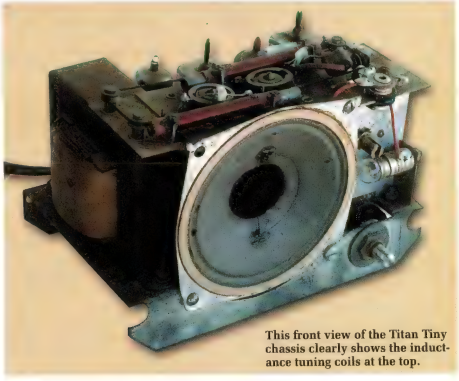
Fig.1: the Titan Tiny is a 4-valve superhet design with inductance tuning. This is a "hot-chassis" set with one side of the mains directly connected to chassis (via a fuse) and the other side connected to chassis via a transformer winding. Hot-chassis sets are real deathtraps, since the metal chassis (and anything connected to it) can operate at 240VAC.

knob missing) underneath. The tuning control is quite small, so tuning the set with its "hand span" type dial is a little tricky.

The rear view of the set reveals a tightly-packed chassis. However, there is sufficient room to remove and replace the valves if necessary. The rear view also shows that the cabinet has a series of "slits" (near the power transformer) – these ensure that there is enough airflow to keep the temperature inside the set at a reasonable level.

Also shown are the four mounting screw-holes (one in each corner) that are used to secure the back of the set. This particular set is missing its back cover and that's an extremely serious safety issue, as will be explained later.

What intrigued me was the size of the set and this can be gauged by comparing the chassis size with a ballpoint pen (see photo). However, despite its small size and the number of components used, the chassis isn't too crowded and this makes it relatively easy to service.



This front view of the Titan Tiny chassis clearly shows the inductance tuning coils at the top.

Circuit details

Fig.1 shows the circuit details of the Titan Tiny. It's a conventional superhet which uses a 6AN7 converter, a 6N8 IF amplifier and detector, and a 6M5 audio stage. The HT is rectified by the ubiquitous 6X4.

At a quick glance, the converter stage appears normal and apparently uses capacitive tuning. However, close inspection reveals that this is not true.

Photo Gallery: AWA Radiola 80 TRF Receiver

Manufactured by AWA in Sydney in 1930, the Radiola 80 featured a "coffin top" style cabinet and a matching loudspeaker in a separate cabinet. This set is a 6-valve TRF receiver and employed the following valve line-up: 3 x type 22 (1st RF amplifier, 2nd RF amplifier & detector), 2 x L410 (1st and 2nd audio) and P410 (audio output). (Photo and information courtesy Historical Radio Society of Australia).

T1 and T2 are not tuning capacitors but are instead high-frequency (1600kHz) trimmers for the aerial and oscillator tuned circuits. However, the circuit symbols used here are for a normal tuning gang and would fool anyone who casually glanced at the circuit (other Titan circuits use recognised symbols for trimmer capacitors).

Actually, this set is inductance tuned by sliding iron-dust cores inside the aerial and oscillator coils. If you carefully examine the photographs of the chassis, you can see the dial cord mechanism that's used for sliding the cores in and out.

Dial cord

Behind the tuning knob, the dial cord is attached to a shaft in much the same way as in many Astor sets. One end then comes up to the top of the set and does a right angle turn around a dial cord pulley so that it runs parallel to a horizontal metal plate. As it progresses across the plate, an iron-dust core is attached to it at a strategic point and this is then threaded through one of the coils. The cord then continues around another two pulleys and then traverses back across the plate and through the second coil (via another iron-dust core).

Finally, the cord goes over another pulley and disappears down to the other side of the dial drive mechanism.

It is a very simple version of the Astor tuning system but I don't believe it is as good. Some other sets, such as the Barlow Wadley XCR30, also used ferrite or iron-dust cores attached to a dial cord for tuning. However, the Barlow Wadley uses just one core, a cam switch and three coils in line to tune the RF stage from 0.5-30MHz with 300° of control rotation. There is certainly nothing wrong with inductance tuning but getting it just right can sometimes be a problem.

Adjusting the two tuned circuits does not appear to be a particularly easy job in the Titan Tiny. Theoretically, it would be possible to shift a slug along the dial cord or to shift the actual location of the coil for best alignment of the circuit. However, it appears to me that it was a once in a lifetime alignment job although a determined restorer should be able to wring the last little bit of performance out of the set.

Padder coil

Most vintage radio restorers have become used to padders being either fixed or adjustable capacitors of around 400-450pF. There is no such thing in this set. If you believe the circuit notations implicitly, it has a padder coil across the oscillator coil. So how does this work?

The inductance of the oscillator coil is less than the aerial coil in most domestic receivers. In this set, however, it appears that the oscillator and aerial coils are the same – both electrically and physically. By paralleling another inductance, the effective inductance of the oscillator coil is reduced to a value equivalent to what other sets use in this position. It also includes a conventional 350pF padder capacitor as well.

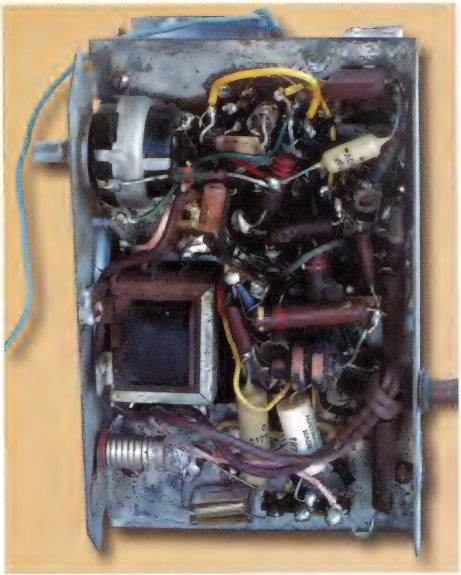
The aerial coil has a capacitor to couple it to the aerial proper. This is a low value "gimmick" capacitor, which ensures that the aerial does not load the aerial tuned circuit to any degree.

This receiver also includes bias and delayed AGC for the 6AN7 and 6N8 valves. This bias (about 0.8V) and de-

WARNING!

The **Titan Tiny** set featured in this article is a hot-chassis set, with one side of the 240VAC mains directly connected to chassis via a fuse and the other side connected to chassis via a transformer winding. **This means that the metal chassis itself and any parts connected to it could easily be operating at 240V AC and this applies even if the fuse (which is actually a dial lamp) blows.**

Under no circumstances should any part of a hot-chassis set be touched while it is plugged into the mains. Hot-chassis sets are extremely dangerous and should be left strictly alone unless you are very experienced and know exactly what you are doing.



The parts were all tightly packed in, as this under-chassis view reveals. The lamp in the bottom lefthand corner served as the mains fuse – crude and potentially lethal for the inexperienced serviceman!

layed AGC is provided by a voltage divider consisting of 50kΩ and 4kΩ resistors from the oscillator's grid.

The audio output stage is a little strange in that the screen of the 6M5 appears to be operating almost in a starvation mode. Most receivers have the screen coming directly off the HT line at the junction of the 2kΩ resistor and the HT supply to the receiver RF stages.

A real deathtrap

We now come to the power supply. At first glance, and without the benefit of a circuit diagram, the Titan Tiny appears to be a conventional mains-operated set with a power transformer. Brian initially thought so and so did I but to Brian's dismay, the mains appeared to have a short to the chassis. As a result, Brian cut the power lead off so that a deadly mistake wasn't made later on when he was endeavouring to restore the set.

Some time later, however, the circuit turned up in the AORSM Manual No.11 (1952) and this showed that **the set is a "hot chassis" type.** So how come it's got a power transformer in it?

Yes, it does have a transformer in it but it is still hot-chassis. In this set, the transformer only supplies the valve filaments and dial lamps. The HT is achieved by wiring the 6X4 as a half-wave rectifier, with one side of the mains connected to the plates via two 350Ω resistors (these limit the peak rectifier current through the 6X4). In addition, a .005μF capacitor (mains rated) is fitted to each plate to suppress interference on the mains.

The Neutral (hopefully) side of the mains goes to the chassis via a fuse, which is actually another dial lamp.

We now return to the missing back on this set. **Without a back, this set would be lethal if it's the mains Active (and not the Neutral) that's connected directly via the fuse to the chassis. In other words, the chassis and much of the circuitry – including the dial lamps – would all be at 240VAC!**

It all depends on which way around the mains is connected.

But here's the rub – **this set is still dangerous even if it's the Neutral that's connected to the chassis via the fuse.** As shown on the circuit, the Active is connected to the chassis via the power transformer's primary. This means that if the fuse blows, the chassis will be at nearly 240V!

If that happens, you yourself could act as the fuse and have nearly 240V placed across your body if you touched the chassis and anything else that is earthed. What a lovely death trap!

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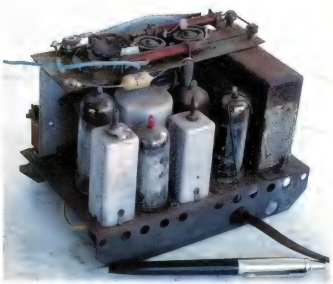

This rear view shows how the major parts fit into the space. The dial-cord is connected to tuning slugs which slide backwards and forwards inside the tuning coils.

A vital part is missing from this Titan Tiny and that's the back. During operation, the chassis could be at 240V AC and that make it potentially lethal.

safety of the user was not considered as important as it is now. To make matters worse, the knob was missing from the volume control on this set and the metal shaft was protruding through the cabinet. Later sets used recessed metal or plastic shafts so that the possibility of an electric shock or worse was eliminated.

I don't know what sort of back was originally attached to this set but I suspect that it was probably a thick cardboard type with perforations for ventilation. The circuit shows a line switch but Brian's set has no such line switch. Perhaps it was removed at some time in the past, when the back was lost?

Restoring the set

This little set isn't up and running yet. It has obviously been serviced in the past, as some of the parts have been replaced with newer components. And with the replacement of a few critical components, there is no reason why this set should not perform quite reasonably.

Tuning of the IF stages should not be a drama but the front-end circuits may prove a bit of a challenge. The Titan Tiny was obviously designed for the lower end of the market, with a simple box-shaped cabinet, a tiny dial scale and no outstanding features to get excited about. But as a kitchen set in a metropolitan setting, it would have been quite adequate.

The biggest black mark against it is the fact that it is a hot-chassis set. This makes it a real deathtrap for the inexperienced serviceman – anyone touching the bare metal chassis or any other parts could easily be touching the mains Active, even if the fuse has blown!

Hot-chassis sets need to be designed with great care if they are to be safe for use by the general public. Some manufacturers were quite conscientious in their endeavours to make their sets safe but others made apparently little effort by today's standards.

Warning label

Would I be pleased to have one of these sets in my collection? Yes, I would – not because I think it's marvellous but because it's an example of a very simple little set that achieves some things in interesting ways.

I would restore it and make it as safe as I could and plaster a big label on the back warning that it is a hot-chassis set. And I would run it through a 1:1 ratio isolation transformer as an additional precaution.

Finally, my thanks to the reader who pointed out the correct spelling for "mantel" in Mailbag for November 2001. Yes, mantel radios were designed to sit on a mantelpiece. **SC**

Photo Gallery: Healing Model 24 TRF Receiver

The Healing Model 24 is a small wooden 3-valve receiver manufactured by A. G. Healing in 1934. The set uses the following valves: 57 detector, 2A5 output and 80 rectifier. (Photo and information courtesy of Historical Radio Society of Australia).

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Measuring mobile phone radiation

Have you ever done a project that measures the radiation from mobile phones/towers? (F. C., Kensington, NSW).

● No we haven't. You need a calibrated yagi or dipole together with a calibrated signal strength meter and possibly a spectrum analyser as well. It is not a simple measurement.

A shocker of a question

I have some questions relating to electric shock. Why don't we feel any electric shock when we touch a 1.5V DC battery? Is it the current too small? Why don't we feel any electric shock when we touch 12V DC car battery? Would we feel any electric shock when we touch a 240V DC battery?

How does electric shock occur? Does it depend on the strength of the electric current and the conductivity of a human being? What is the minimum current that causes a tingling feeling? (K. W., via email).

● The severity of electric shock is directly related to the current that flows. A few milliamps causes tingling while 10mA is quite severe and enough to kill a child in some instances. In normal circumstances you need more than about 40V to cause a shock or tingle but where you make really good contact (ie, with both hands moistened and around large metal contacts) you can get a substantial shock with as little as 12V. A 240V battery could easily kill you.

Triac for darkroom timer

Back in April 1995 you published a circuit for a Darkroom Timer. I'm trying to find a replacement for the MAC-320A8PF Triac as this device is no longer available. Can you help? (B. W., via email).

● Use the Philips BT137F (F stands for isolated tab). You can buy it from Jaycar.

Some motors don't like low speeds

I have only just read the "Ask Silicon Chip" section of the September 2001 issue. Regarding the 'Power Rating For Speed Controller' question, even though the speed controller may be suitable for continuous use, the motor concerned may object to being used at a reduced speed for a long period.

Motors are designed to run at their rated speed, usually being cooled by their own internal fan. When they run at a reduced speed the cooling airflow is reduced and they can overheat sometimes to the point of burnout.

If the motor concerned is a fixed one it may be possible to install a separate cooling fan (eg, computer fan) to keep it within its rated temperature. I hope this information is of use. (B. A., via email).

Extra inputs for AV distribution amplifier

I would like be able to add additional (switchable) inputs to the Audio/Video Distribution Amplifier featured in the November 2001 issue, to cope with the situation of say using separately a cable TV box, two VCRs & DVD, feeding a TV, and also feeding the output 'back' to the VCR's line-input for recording/dubbing, plus (sound) to a hifi system.

This situation must be quite a usual setup in the home and would cope with recording the 'input' device at any time whether the TV was on or off.

Is it just a case of buying a video switch box to use before the distribution amplifier or is there a more elegant solution? Or has a project been designed for this purpose? (B. F., Brighton, Vic).

● The best way is to use an AV switch box ahead of the distribution amplifier, as you suggest. Trying to build input source switching into the amp would be messy. A switch box should be fine. But note that the audio channel output resistors should be reduced from 47kΩ to 1kΩ or so.

● You make a good point although it is one that we have covered before albeit not in the constructional article.

World TV frequencies

I need to know the actual TV transmitting frequencies (not channel numbers) for the TV systems in UAE and Saudi Arabia. I have searched high and low. Please help. (M. A., via email).

● The ideal source for this info is the World Radio & TV Handbook. It is available from Dick Smith Electronics at $47.88; Cat B-2101.

Video sharpening with Dr Video

I've recently bought the kit for the Dr Video and have tried it out. Although the picture was pretty good, it was not quite as good as I would have liked it to be. In the kit instructions it says: "by varying the 330Ω resistor up or down you can change the amount of high frequency video boosting given by the Sharpen switch". What would be the absolute maximum I should vary it or what is the next best resistor value to use? I also have the same questions about the 82pF capacitor. (P. B., via email).

● The limit to video sharpening comes about when you observe more noise and graininess in the picture. So vary the resistor and capacitor with this fact in mind.

Bigger lamp for rev limiter

I have just purchased a kit for the Rev Limiter published in the April 1999 issue. I want to know if it is possible to replace the indicator lamps with relays to operate a much bigger indicator light, say a 21W bulb , as I run a racecar and want an indicator that I will notice. (T. M., via email)

● You can replace each lamp with a 12V relay and a diode, with the anode to the transistor collector and cathode to 0V; ie, the diode is reverse-biased.

Testing frequency response of speakers

I'm trying to find out how to measure the frequency response of my speakers. Can you help me? (A. H., via email).

● Measuring frequency response of speakers is not simple and you would be wise to refer to a textbook on this subject. For the simplest of tests, you will need an audio generator or a CD with test frequencies on it, a calibrated microphone and an AC millivoltmeter with a wide bandwidth.

Radfax decoder software

Can you please supply the software for the Radfax decoder featured in the November 1989 issue of SILICON CHIP? I have contacted the Author, Michael Delahunty, but he can no longer supply it, due to a past computer crash. (A. M., Reservoir, Vic).

● We do not have the software either but perhaps a reader can send it to us, whereupon we will send it to the author (and to you).

How to stop rust on camera screws

I have a question that you may be able to answer. I have an older video camera that had a problem with the zoom motor. Minor problem, easy to fix, however, after removing the original factory screws, and putting them back again, the screws have 'oxidised' and are starting to rust very quickly.

I had the same problem with the internal mechanism screws of my VCR. Is this a tamper-proof feature? Is there any way to prevent the screws from going rusty? (A. P., via email).

● Our guess is that the screws originally had some protective clear enamel

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More current for white LED torch

I recently purchased a kit for the 6 white-LED torch (published May 2001) from Dick Smith Electronics. I notice that the LEDs are rated for a continuous forward current of up to 30mA (and can tolerate spikes of up to 200mA for less than 10 microseconds) but that the circuit delivers 18.5mA.

You say that in practice the current is slightly higher than this but you don't specify by how much. Am I likely to destroy the LEDs if I replace the 27Ω resistors in series with the LEDs with 20Ω or 18Ω resistors, giving a current of 25mA and 28mA respectively to each LED? I would like to make the torch as bright as possible but I do not want to put the LEDs in jeopardy. (S. H., via email).

● We do not recommend driving the LEDs with more current than that afforded by the 27Ω resistors. This is because the turn on voltage for the LED could be lower than the typical 3.5V, causing a higher current flow.

The only realistic way to measure and reset the LED current to a higher value is to measure the voltage across each resistor and the replace the resistor with a value which will provide the desired current.

Also the inverter driving the LEDs is not suitable for driving all six LEDs at 30mA as it does not have this much power output.

over them which you have disturbed, allowing corrosion to proceed. Possible tip: put clear nail varnish over the screws that have been disturbed.

Surround sound amplifiers

I recently built the surround sound decoder and digital delay board from the May 1999 issue of "Electronics Australia" and would like to build suitable amplifiers for the centre and rear surround channels. The rear channel usually has two speakers in parallel which would result in a 4Ω load.

My main amplifier is capable of 50 watts RMS per channel. Could you advise me of the power output required for the rear and centre channels that would be a suitable mix for my current main amplifier? (Y. C., via email).

● Have a look at the 50W module described in the March 1994 issue of SILICON CHIP. Kits are available from DSE, Jaycar, etc. We can supply the March 1994 issue for $7.70, including postage.

Glue gun temperature control

I am using a 10W 240VAC glue gun to make candles and I find it gets far too hot for the wax I am using. What is the best way to control the temperature? (A. Q., Adelaide, SA).

● Have a look at the article entitled "Power Control With a Light Dimmer" in the October 1996 issue. Although this article described power control for soldering irons, the idea is equally applicable to glue guns.

Leakage on engine immobiliser

I am enquiring about the Engine Immobiliser described in the December 1998 issue. The immobiliser board has about 0.4MΩ across collector and ground of Q1 when in the idle state. This is enough to affect the points and not allow starting when the unit is not turned on.

Everything works well with the overall kit and all is OK once the standing 12V is removed from the board. Is there a correction for this or do I need to look at my own handiwork? (B. M., via email).

● Try shorting the base and emitter of Q1. If this eliminates the 0.4MΩ, it suggests that you may have leakage in the earlier stages or across the PC board itself.

Notes & Errata

LP Doctor, January 2001: in order to avoid residual mains voltage across the transformer when the power switch is off, the associated .01µF/250VAC capacitor should be reduced to .001µF/250VAC. **SC**

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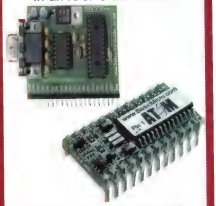

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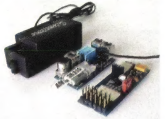

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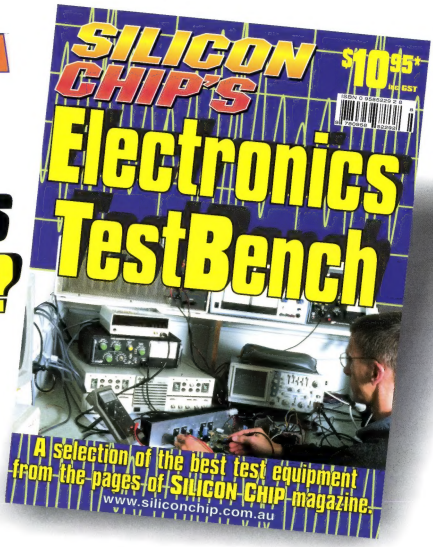

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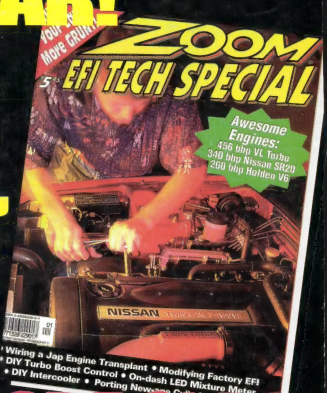

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